FUEL CELL SYSTEM

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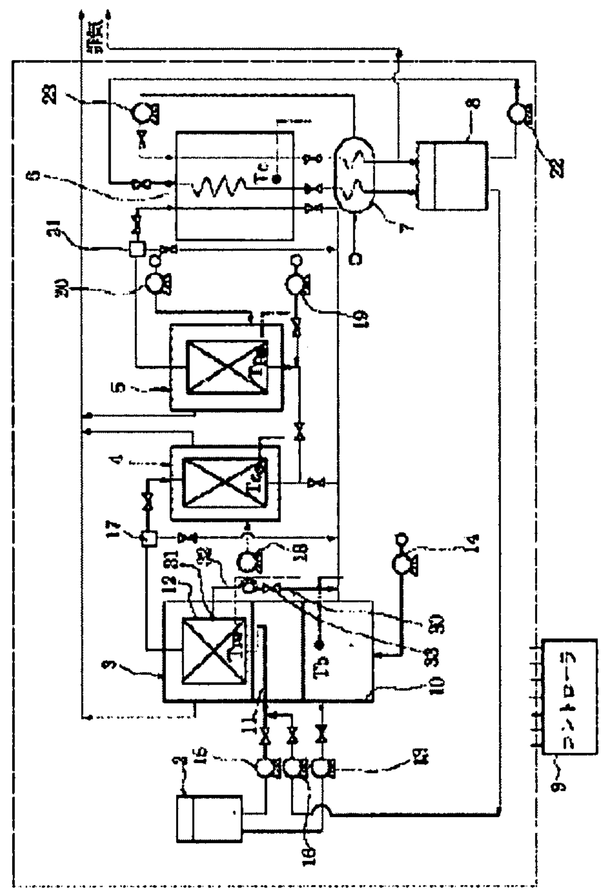
Abstract of **JP2002117883**

PROBLEM TO BE SOLVED: To maintain a performance of a cell of a fuel cell even if it is in a state of operation of starting, stopping, or the like. SOLUTION: In a fuel cell system 1 which generates electricity by supplying air containing hydrogen and oxygen to a cell 106 of the fuel battery, the fuel cell 6 is constituted with a cell stack 103 constituted by laminating of an electrode base material B which consists of an ion exchange film 107, a positive catalyst electrode 108, and a negative catalyst electrode 109, and a water storage part A which absorbs the water in the electrode base material B during excess water of the electrode base material B, and supplies water to the electrode base material B during water shortage of the electrode base material B. While arranging the water storage part A approaching to the electrode base material B, water is supplied to the water storage part A continuously from outside of the cell stack 103, immediately after a power generation stop of the fuel cell 6. The water is kept in the water storage part A, and it is constituted so that the water of the water storage part A may be supplied to the electrode base material B at the start-up of the fuel cell 6.



JAPANESE [JP,2002-117883,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1] In the fuel cell system which generates electricity by supplying the air containing hydrogen and oxygen to the cel of a fuel cell The cel stack constituted by said fuel cell carrying out the laminating of the electrode substrate which consists of ion exchange membrane, a forward catalyst electrode, and a negative catalyst electrode, While consisting of the water storage section which absorbs the water in said electrode substrate at the time of the overwater of said electrode substrate, and supplies water to said electrode substrate at the time of the water shortage of said electrode substrate, approaching said electrode substrate and arranging said water storage section The fuel cell system characterized by constituting so that water is continued and supplied to said water storage section from the exterior of said cel stack immediately after a generation-of-electrical-energy halt of said fuel cell, water may be kept in said water storage section and the water of said water storage section may be supplied to said electrode substrate at the time of starting of said fuel cell.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the fuel cell system which reforms a raw material, manufactures hydrogen and generates electricity by supplying the obtained hydrogen to a fuel cell.
[0002]
[Description of the Prior Art] As a fuel cell system, an evaporator is heated with a heater, by the reformer which supplied the raw material evaporated with this evaporator to the catalyst bed, a raw material is reformed, hydrogen is manufactured, and there are some which generate electricity by supplying the obtained hydrogen to a fuel cell.
[0003]
[Problem(s) to be Solved by the Invention] In a fuel cell, it serves as overwater feeling, and a water shortage and generation-of-electrical-energy termination to a halt serves as overwater feeling from starting by the steady state to a stationary. For this reason, the complicated water supply control doubled with each operation mode was required. Even if the surrounding humidity of the ion exchange membrane accompanying the temperature rise of the cel of a fuel cell was large and supplied water from the exterior, since the cel of a fuel cell had got cold, the steam condensed to the gas passageway on the way especially at the time of starting, and it was not fully able to humidify ion exchange membrane of an electrode substrate.
[0004] Thus, the engine performance of the cel of a fuel cell deteriorated, and that humidity control is difficult had also become the cause that the cel engine performance could not fully be taken out in early stages of a generation of electrical energy.
[0005] Moreover, a lot of water was needed and bad influences, such as gas-passageway lock out by it, were also generated.
[0006] Moreover, when it uses for migration, the amount of supply of the water needed for the cel of a fuel cell is violently changed with a load level, cel temperature, etc. On the other hand, the amount of humidification cannot be equivalent to the speed of the change. Therefore, it was difficult to control the amount of humidification proper.
[0007] Furthermore, when water was supplied by the peak price of fluctuation so

that humidifying might not become insufficient, it became hydration, and diffusion paths of gas, such as pore of the carbon paper which is an electrode substrate, were got blocked with water, and there was a problem that the engine performance of a cel fell. Moreover, when water was supplied by the average in consideration of fluctuation of water, the excess and deficiency of supply will be repeated and the engine performance of a cel was not fully able to be taken out.
[0008] This invention was made in view of this point, and aims at offering the fuel cell system which can maintain the engine performance of the cel of a fuel cell also by operational status, such as starting and a halt.
[0009]
[Means for Solving the Problem] In order to solve said technical problem and to attain the purpose, invention according to claim 1 In the fuel cell system which generates electricity by supplying the air containing hydrogen and oxygen to the cel of a fuel cell The cel stack constituted by said fuel cell carrying out the laminating of the electrode substrate which consists of ion exchange membrane, a forward catalyst electrode, and a negative catalyst electrode, While consisting of the water storage section which absorbs the water in said electrode substrate at the time of the overwater of said electrode substrate, and supplies water to said electrode substrate at the time of the water shortage of said electrode substrate, approaching said electrode substrate and arranging said water storage section Water is continued and supplied to said water storage section from the exterior of said cel stack immediately after a generation-of-electrical-energy halt of said fuel cell, water is kept in said water storage section, and it is characterized by constituting so that the water of said water storage section may be supplied to said electrode substrate at the time of starting of said fuel cell.
[0010] Thus, by supplying the water of the water storage section at the time of starting, at the time of starting, since the water storage section goes up at the almost same temperature as a cel, compared with what supplies water, exact humidity management can be performed from the exterior. Moreover, since water can be kept in the condition of having contained the interior or near the cel, at the time of a halt, it is possible to maintain the humidity of the electrode substrate of a cel at a saturation state mostly also during storage.
[0011] Furthermore, supply control of the water of a fuel cell is easy, and the supply of the water corresponding to a load effect of it is attained at the time of a generation of electrical energy. Moreover, since the amount of supply of water can be made into the minimum which needs a cel, the miniaturization of reduction of the amount of the water used, reduction of pump power required for water supply, reduction of the amount of heating, the evaporation section, a heat exchanger, etc. and the miniaturization of a water tank are possible, and efficient and small lightweight-ization are attained.
[0012] Furthermore, supply control of the water of a fuel cell is easy, and the supply of the water corresponding to a load effect of it is attained at the time of a generation of electrical energy. Moreover, since the amount of supply of water can be made into the minimum which needs a cel, the miniaturization of reduction of the amount of the water used, reduction of pump power required for water supply, reduction of the amount of heating, the evaporation section, a heat exchanger, etc.

and the miniaturization of a water tank are possible, and efficient and small lightweight-ization are attained.
[0013]
[Embodiment of the Invention] Hereafter, the example of the fuel cell system of this invention is explained to a detail based on a drawing.
[0014] Drawing 1 is the block diagram showing the example of a fuel cell system.
[0015] An electric vehicle is equipped with the fuel cell system 1, and it has some which run the electrical and electric equipment generated with a fuel cell as a driving source. This fuel cell system 1 consists of the methanol tank 2, a reformer 3, a shift converter 4, the selective oxidation reactor 5, the fuel cell 6, a moisture recuperator 7, a water tank 8, and controller 9 grade. The controller 9 is connected with each device, such as a bulb, a pump, and a fan, and a sensor. Each part of a reformer 3, a shift converter 4, the selective oxidation reactor 5, and a fuel cell 6 is equipped with temperature sensors Tr, Tb, Ts, Tp, and Tc, and each part is controlled by these temperature detection by proper temperature by the controller 9.
[0016] The reformer 3 is equipped with the heater 10, the evaporator 11, and the catalyst bed 12 grade. In a heater 10, the burner pump 13 drives by temperature detection of temperature sensor Tb, and a methanol is supplied from the methanol tank 2 to it, and air is supplied by drive of the burner fan 14 to it, it burns in these in it, and an evaporator 11 is heated to it. By the drive of the methanol pump 15, with the methanol supplied from the methanol tank 2, the water supplied from a water tank 8 by the drive of a water pump 16 is mixed in an evaporator 11, and it is supplied again. The fuel which heated the evaporator 11 with the heater 10, evaporated the composite fuel of a methanol and water, and was evaporated with this evaporator 11 is supplied to a catalyst bed 12.
[0017] By this reformer 3, a raw material is reformed, hydrogen is manufactured, and the hydrogen obtained by temperature detection of a temperature sensor Tr is supplied to a fuel cell 6 through a shift converter 4 and the selective oxidation reactor 5. A change-over valve 17 is formed between a reformer 3 and a shift converter 4, and hydrogen is returned to the heater 10 of a reformer 3 by actuation of this change-over valve 17. A shift converter 4 is cooled by temperature detection of a temperature sensor Ts by the air fan 18 for cooling. The air supplied by the drive of the air pump 19 for a reaction is mixed in the hydrogen sent from a shift converter 4, and it is supplied at the selective oxidation reactor 5. The selective oxidation reactor 5 is cooled by temperature detection of a temperature sensor Tp by the air fan 20 for cooling. A change-over valve 21 is formed between the selective oxidation reactor 5 and a fuel cell 6, and hydrogen is returned to the heater 10 of a reformer 3 by actuation of this change-over valve 21.
[0018] To a fuel cell 6, water is supplied from a water tank 8 by the drive of the cooling humidification pump 22, and air is supplied by temperature detection of temperature sensor Tc from the moisture recuperator 7 by the drive of the pressurization air pump 23 to it, and it generates electricity from these water, air, and hydrogen with a fuel cell 6 to it. The water used with the fuel cell 6 obtains water by heat exchange with the moisture recuperator 7, and is returned to a

water tank 8. Moreover, the hydrogen used with the fuel cell 6 for the generation of electrical energy is returned to the heater 10 of a reformer 3.
[0019] By the reformer 3 which supplied the raw material which heated the evaporator 11 and was evaporated with this evaporator 11 with the heater 10 to the catalyst bed 12 in the fuel cell system 1 A raw material is reformed, hydrogen is manufactured and it generates electricity by supplying the obtained hydrogen to a fuel cell 6 through a shift converter 4 and the selective oxidation reactor 5. A reformer 3 A part of reactant gas by fuel reforming is taken out from the middle of a catalyst bed 12, and it constitutes so that it may return to a heater 10 through the return system 30. The return system 30 consists of piping 32 which connects the reactant gas fetch section 31 prepared in the catalyst bed 12 side, this reactant gas fetch section 31, and a heater 10 side, and a bulb 33 with which this piping 32 was equipped, takes out a part of reactant gas by fuel reforming from a catalyst bed 12 by opening a bulb 33, and is returned to a heater 10. As for a bulb 33, an ON/OFF bulb or a positive crankcase ventilation valve is used.
[0020] Next, the concrete example of a fuel cell is explained based on drawing 2 thru/or drawing 4 . The sectional view where drawing 2 meets the front view of a fuel cell, and drawing 3 meets the III-III line of drawing 2 , and drawing 4 are sectional views which meet X-X-ray and the Y-Y line of drawing 2 .
[0021] The fuel cell 6 is equipped with the cel stack 103 attached by ****** 102. The cel stack 103 is carried out for constructing Separators 104a, 104b, and 104c, two or more laminatings of it are carried out, it is attached, and is constituted, and 104d of gas cutoff plates is formed between separator 104a and separator 104c. Tunnel path 115b is formed between 104d of gas cutoff plates at separator 104c. Among Separators 104a and 104b, it has the cel 106. The electrode substrate B of a cel 106 consists of ion exchange membrane 107, a forward catalyst electrode 108, and a negative catalyst electrode 109. Periphery section 107a of ion exchange membrane 107 is inserted and held among Separators 104a and 104b, it has the catalyst electrode 108 of ion exchange membrane 107 forward to a field on the other hand, has the negative catalyst electrode 109 in the another side side, makes the hydrogen and oxygen of reactant gas react by this cel 106, generates water, and generates the electrical and electric equipment in that case.
[0022] The porous guide object 110 formed in the outside of the forward catalyst electrode 108 of a cel 106 by the porous member is contacted, and it is arranged, and the porous guide object 111 formed also in the outside of the negative catalyst electrode 109 by the porous member is contacted, it is arranged, and the water storage section A for the absorption at the time of overwater and the supply at the time of a water shortage on the outside of an electrode substrate consists of porous members.
[0023] The porous guide object 110,111 is fabricated by the porosity porous member, and Slots 110a and 111a are formed in the whole surface side at equal intervals, respectively. The porous guide object 110 contacts the side in which slot 110a was formed to the forward catalyst electrode 108, and the porous guide object 111 is arranged towards the direction which intersects slot 111a perpendicularly with slot 110a of the porous guide object 110. The reactant gas path 112 which is open for free passage between slot 110a of the porous guide

object 110 and the forward catalyst electrode 108 is formed, and the reactant gas path 113 which is open for free passage between slot 111a of the porous guide object 111 and the negative catalyst electrode 109 is formed.

[0024] A cel 106 does the include-angle alpha inclination of, and is arranged, a gasket 114 is formed among the separators 104b and 104c surrounding the perimeter of a cel 106, and the seal of the cel 106 is carried out to the cel stack 103 with the gasket 114. The inlet-port section 115 of hydrogen is formed in the left-hand side upper part of the cel stack 103, the outlet section 116 of hydrogen is formed in a right-hand side lower part, a gasket 117,118 is formed among Separators 104a and 104b so that the perimeter of the inlet-port section 115 and the outlet section 116 may be surrounded, and the seal of the inlet-port section 115 and the outlet section 116 is carried out. Inlet-port path 115a is formed in the direction of a laminating of a cel 106 at the inlet-port section 115, four tunnel paths 115b is open for free passage from this inlet-port path 115a to distribution path 115c of a cel 106 through the lower part of a gasket 114, and it is open for free passage from distribution path 115c to the reactant gas path 113. In the outlet section 116, outlet path 116a is formed in the direction of a laminating of a cel 106, four tunnel paths 116b opened for free passage by this outlet path 116a is open for free passage to set path 116c of a cel 106 through the lower part of a gasket 114, and set path 116c is open for free passage with the reactant gas path 113.

[0025] The inlet-port section 119 of oxygen is formed in the upper part right-hand side of the cel stack 103, the outlet section 120 of oxygen is formed in lower part left-hand side, a gasket 121,122 is formed among Separators 104a and 104b so that the perimeter of the inlet-port section 119 and the outlet section 120 may be surrounded, and the seal of the inlet-port section 119 and the outlet section 120 is carried out. Inlet-port path 119a is formed in the direction of a laminating of a cel 106 at the inlet-port section 119, four tunnel paths 119b is open for free passage from this inlet-port path 119a to distribution path 119c of a cel 106 through the lower part of a gasket 114, and it is open for free passage from distribution path 119c to the reactant gas path 112. In the outlet section 120, outlet path 120a is formed in the direction of a laminating of a cel 106, four tunnel paths 120b opened for free passage by this outlet path 120a is open for free passage to set path 120c of a cel 106 through the lower part of a gasket 114, and set path 120c is open for free passage with the reactant gas path 112.

[0026] Moreover, the water path 123 is formed in the contact section with the porous guide object 110 which is an inferior surface of tongue in drawing 3 of 104d of gas cutoff plates. The discharge section 124 prepared in the bottom near the inlet-port section 115 of hydrogen through tunnel path of water path 123 where 123a passes along lower part of gasket 114 on the other hand 124a is open for free passage, and another side 123b is opened for free passage by the feed zone 125 prepared in the bottom near the outlet section 116 of hydrogen through tunnel path 125a which passes along the lower part of a gasket 114. Gaskets 126a and 127a are formed among Separators 104a and 104c so that the perimeter of the discharge section 124 and a feed zone 125 may be surrounded, and the seal of the discharge section 124 and the feed zone 125 is carried out.

[0027] Moreover, the water path 128 is formed in the contact section with the porous guide object 110 which is a top face in drawing 3 of separator 104b. The discharge section 129 prepared in right-hand side near the inlet-port section 119 of oxygen through tunnel path of water path 128 where 128a passes along lower part of gasket 114 on the other hand 129a is open for free passage, and another side 128b is opened for free passage by the feed zone 130 prepared in left-hand side near the outlet section 120 of oxygen through tunnel path 130a which passes along the lower part of a gasket 114. Gaskets 126b and 127b are formed among Separators 104a and 104b so that the perimeter of the discharge section 129 and a feed zone 130 may be surrounded, and the seal of the discharge section 129 and the feed zone 130 is carried out.
[0028] Therefore, if the hydrogen warmed and humidified is supplied from the inlet-port section 115 of the hydrogen of the cel stack 103, the hydrogen containing this moisture will be led to distribution path 115c of a cel 106 through inlet-port path 115a to tunnel path 115b, and will flow the reactant gas path 113 from distribution path 115c. On the other hand, if the oxygen warmed and humidified is supplied from the inlet-port section 119 of oxygen, the oxygen containing this moisture will be open for free passage to distribution path 119c of a cel 106 through inlet-port path 119a to tunnel path 119b, and will flow the reactant gas path 112 from distribution path 119c.
[0029] At this time, by the cel 106, water is generated and the generation of electrical energy which takes out change of the free energy in that case as electrical energy is performed by the electrochemical reaction of the hydrogen and oxygen of reactant gas. A cel 106 is connected at the cel 106 and serial which adjoined through separator 104c, and the generated power is taken out from the current collection section which is not illustrated [which was prepared in the both ends of the cel stack 103].
[0030] Hydrogen and water are brought together in set path 116c of a cel 106, are led to outlet path 116a through tunnel path 116b, and are mainly discharged from the outlet section 116. Oxygen and water are brought together in set path 120c of a cel 106, are led to outlet path 120a through tunnel path 120b, and are mainly discharged from the outlet section 120.
[0031] a cel -- 106 -- depending -- hydrogen -- oxygen -- being electrochemical -- a reaction -- one side -- **** -- oxygen -- water -- porous one -- a guide -- the body -- 110 -- forward -- a catalyst -- an electrode -- 108 -- a passage -- ion exchange membrane -- 107 -- a front face -- supplying -- having -- another side -- **** -- hydrogen -- water -- porous one -- a guide -- the body -- 111 -- negative -- a catalyst -- an electrode -- 109 -- a passage -- ion exchange membrane -- 107 -- a front face -- supplying -- having -- this -- forward -- a catalyst -- an electrode -- 108 -- ion exchange membrane -- 107 -- an interface -- and -- negative -- a catalyst -- an electrode -- 109 -- ion exchange membrane -- 107 -- an interface -- carrying out -- having -- . Since elongation changes with water content a lot, ion exchange membrane 107 needs to always keep proper the humidification level of ion exchange membrane 107, to keep the elongation of ion exchange membrane 107 constant, and to maintain an interface at stability.

[0032] Although the electrical and electric equipment occurs at the electrochemical reaction of the hydrogen and oxygen of the reactant gas by this cel 106 and water is generated in that case Although the engine performance of elongation and a cel 106 will deteriorate further if superfluous water, such as the water of condensation generated not only in the elongation by the relative humidity of this cel 106 interior but in the interior, generation water, and oversupply water, contacts ion exchange membrane 107 directly The porous guide object 110,111 was contacted to the catalyst electrode 108,109 of the both sides of a cel 106, and it arranges, and superfluous water, such as the water of condensation generated in the cel 106 interior, generation water, and oversupply water, can be absorbed with the porous guide object 110,111, and can be removed.
[0033] For this reason, the elongation of ion exchange membrane 107 could be prevented, and the engine performance of a cel 106 could be kept efficient for a long period of time, and the diffusibility fall of reactant gas is prevented. Thus, superfluous water can be removed without using special equipment, and it can consider as simplicity, a low price, a compact, and lightweight equipment. When supplying water by forming the reactant gas path 112,113 with the porous guide object 110,111, it is absorbed with the porous guide object 110,111, and a part is diffused to the reactant gas path 112,113, while humidifying effectively by moving to the direct catalyst electrode 108,109, when superfluous water is generated, a part has the damper effectiveness which absorbs this and is supplied at the time of lack, and humidification of optimum dose is possible for it.
[0034] Moreover, the water storage section A for the absorption at the time of overwater and the supply at the time of a water shortage on the outside of the electrode substrate which consists of ion exchange membrane 107, a forward catalyst electrode 108, and a negative catalyst electrode 109 is formed in the cel stack 103 interior of a fuel cell 6, and water is kept in the water storage section A at the time of a halt, and it constitutes so that the water of the water storage section A may be supplied at the time of starting.
[0035] Thus, by supplying the water of the water storage section A at the time of starting of a fuel cell, at the time of starting, since the water storage section A goes up at the almost same temperature as a cel 106, compared with what supplies water, exact humidity management can be performed from the exterior. Moreover, since water can be kept in the water storage section A in the condition of having contained the interior or near the cel 106, at the time of a halt, it is possible to maintain mostly the humidity of the ion exchange membrane 107 of a cel 106 at a saturation state also during storage.
[0036] Furthermore, supply control of the water of a fuel cell 6 is easy, and the supply of the water corresponding to a load effect of it is attained at the time of a generation of electrical energy. Moreover, since the amount of supply of water can be made into the minimum which needs a cel 106, the miniaturization of reduction of the amount of the water used, reduction of pump power required for water supply, reduction of the amount of heating, the evaporation section, a heat exchanger, etc. and the miniaturization of a water tank are possible, and efficient and small lightweight-ization are attained.
[0037] Moreover, water is kept in the water storage section A at the time of

starting, and it constitutes so that the water of the water storage section A may be supplied at the time of a stationary. Thus, by supplying the water of the water storage section A at the time of a stationary, at the time of starting, the water of condensation and superfluous water can be secured and the amount of supply of humidification water can be reduced. Moreover, during starting, since the water which is not contributed to humidification is removed from a gas passageway, the engine performance is highly maintainable from generation-of-electrical-energy initiation.
[0038] Furthermore, supply control of the water of a fuel cell 6 is easy, and the supply of the water corresponding to a load effect of it is attained at the time of a generation of electrical energy. Moreover, since the amount of supply of water can be made into the minimum which needs a cel, the miniaturization of reduction of the amount of the water used, reduction of pump power required for water supply, reduction of the amount of heating, the evaporation section, a heat exchanger, etc. and the miniaturization of a water tank are possible, and efficient and small lightweight-ization are attained.
[0039] Drawing 5 thru/or drawing 8 show other examples of the water storage section. The water storage section A of drawing 5 has multilayer structure, the 1st storage section A1 is formed by the porous member which has a path 300, and the 2nd storage section A2 is similarly formed by the porous member. Although water is absorbed and held from the path 300 of the 1st storage section A1 at the 2nd storage section A2, from the 2nd storage section A2, the 1st storage section A1 has good water absorption, and has increased water capacity by making the water storage section A into multilayer structure.
[0040] The water storage section A of drawing 6 has multilayer structure, the 1st storage section A1 is formed by the porous member which has a path 300 similarly, and the 2nd storage section A2 is formed by the porous member or non-permeated material. It has the crevice in the 1st storage section A1 side of the 2nd storage section A2, space is formed between this crevice and the 1st storage section A1, and the path 301 is formed in this space. Although water is absorbed and held from the path 300 of the 1st storage section A1 at the 2nd storage section A2, water is further held so much and certainly by the path 301.
[0041] Although the water storage section A of drawing 7 has multilayer structure, the 1st storage section A1 is formed by the porous member which has a path 300 and the 2nd storage section A2 is similarly formed by the porous member, the non-permeated material C is arranged on the outside of this 2nd storage section A2. Between paths 300, the guide path 302 which opens the outside and the 2nd storage section A2 of an electrode substrate B for free passage is formed at the 1st storage section A1. Moreover, the water path 303 is formed in the 2nd storage section A2 between the non-permeated material C. Therefore, by lengthening with negative pressure, water is absorbed by the 1st storage section A1 from a path 300, it is further absorbed by the guide path 302 at the 2nd storage section A2, and water absorption is quick.
[0042] The water storage section A of drawing 8 has multilayer structure, the 1st storage section A1 is formed by the porous member which has a path 300, and the non-permeated material C is arranged on the outside of this 1st storage section

A1. The water path 304 is formed between the 1st storage sections A1, and water is smoothly supplied to the non-permeated material C from the water path 304 at the 1st storage section A1.
[0043] Drawing 9 and drawing 10 show the arrangement location of the water storage section A. In the example of drawing 9 , the gas passageway 400 is formed in the both sides of the cel 106 which consists of electrode substrates, and the water storage section A is formed in the space of this gas passageway 400. Thus, it is arranged in the location where the water storage section A separated from the cel 106 of an electrode substrate, and the water supplied with a water pump 401 is kept by the water storage section A.
[0044] In the example of drawing 10 , the inlet-port section 115 of hydrogen and the outlet section 116 of hydrogen are formed in the both sides of the cel 106 which consists of electrode substrates. Inlet-port path 115a is formed in the direction of a laminating of a cel 106 at the inlet-port section 115, four tunnel paths 115b is opened for free passage by distribution path 115c of a cel 106 from this inlet-port path 115a, and the water storage section A is formed in this entrance side.
[0045] Moreover, outlet path 116a is formed in the direction of a laminating of a cel 106 at the outlet section 116, four tunnel paths 116b is opened for free passage by set path 116c of a cel 106 from this outlet path 116a, and the water storage section A is formed in this outlet side.
[0046] Next, operation of a fuel cell system is explained based on drawing 11 . In drawing 11 (a), characteristic curves b1 and c1 show this invention for operation of the former [characteristic curve / a1], respectively. Moreover, in drawing 11 (b), characteristic curves b2 and c2 show this invention for operation of the former [characteristic curve / a2], respectively.
[0047] In the conventional thing, supply of the steam to a fuel cell is gradually suspended immediately after halt actuation of a fuel cell system at the time of a halt. The humidity inside a cel changes with surrounding temperature at the time of storage. If temperature approaches saturated humidity gradually by fall and exceeds it, moisture condenses and a path etc. is blockaded. Moreover, since the water of condensation is unevenly distributed even if temperature rises, there is little humidification effectiveness to the film of an electrode substrate. The preparations (a pump is driven and a steam is made by heating or heat exchange.) for supplying water (or steam) from the exterior in advance of generation-of-electrical-energy initiation at the time of starting are made. While raising the temperature of a cel to proper temperature with generation-of-electrical-energy initiation, water (or steam) is supplied from the exterior. Since it is necessary to change the moisture amount of supply at the time of a generation of electrical energy according to the temperature of an output and a cel etc., there is a problem of having to change the amount of humidification frequently.
[0048] Supply of the steam(water) from the outside of a fuel cell is not suspended at the time of a generation-of-electrical-energy halt of a fuel cell, but it is the same as the time of a generation of electrical energy, or sending the flow rate beyond it is continued, and the water storage section A is made to absorb as water in the example of drawing 11 (b) which is the fuel cell system 1 of this invention. In

the time of storage, it is maintained at the saturated humidity by surrounding temperature, and a condensed part is absorbed further. The temperature of a cel 106 is raised to proper temperature with generation-of-electrical-energy initiation at the time of starting. Heat tracing or self-generation of heat is used for this. In early stages, water (or steam) supply from the outside is not performed, but the water of the water storage section A is used. Temperature rises with the rise of cel temperature and the water of the water storage section A evaporates to the gas passageway. Thereby, a gas passageway is maintained near the saturated humidity. Only by humidification by natural evaporation of storage water, since there is a limitation in time, in order to shorten warm-up time, water (or steam) is supplied from the exterior after fixed time amount progress. Since absorption and emission efficiency of moisture can be used at the time of a generation of electrical energy, even if it does not change the amount of humidification frequently, proper humidification control is possible.
[0049] Moreover, in the example of drawing 11 (c), supply of water (steam) is gradually suspended immediately after halt actuation of a system at the time of a halt. It is maintained at the saturated humidity by surrounding temperature in the time of storage. A condensed part is absorbed further. The preparations (a pump is driven and a steam is made by heating or heat exchange.) for supplying water (or steam) from the exterior in advance of generation-of-electrical-energy initiation at the time of starting are made. While raising the temperature of a cel to proper temperature with generation-of-electrical-energy initiation, water (or steam) is supplied from the exterior. Since some water of the water storage section A can be used, in early stages, water (or steam) supply from the outside is not performed, but the water of the water storage section A is used. Therefore, there is little water amount of supply compared with the former, and it ends. Supplying water, water is kept in the water storage section A, and it uses for humidity management later. Since absorption and emission efficiency of moisture can be used at the time of a generation of electrical energy, even if it does not change the amount of humidification frequently, proper humidification control is possible.
[0050] Drawing 12 is the block diagram showing other examples of a fuel cell system. Although constituted like drawing 1 , the fuel cell 6 of this example is constituted so that the air heated by delivery and this heating unit 501 in air from the water tank 8 by the heating unit 501 which is arranged by the drive of the pump 500 for air at a reformer 3 unlike drawing 1 may be sent to the entrance side 502 of a fuel cell 6. Moreover, it is constituted so that the water heated by delivery and this heating unit 511 in water from the water tank 8 by the heating unit 511 arranged by the drive of the humidification pump 510 for water at a reformer 3 may be sent to the entrance side 512 of a fuel cell 6.
[0051] a fuel cell 6 -- a hydrogen side -- an inlet port -- moisture -- many -- moreover, an air side -- an outlet -- moisture -- it becomes [many]. For this reason, the air heated by delivery and this heating unit 501 by the heating unit 501 arranged by the drive of the pump 500 for air to predetermined timing at a reformer 3 is sent to the entrance side 502 of a fuel cell 6. Moreover, the hydrogen heated by delivery and this heating unit 511 in hydrogen from the water tank 8 by the heating unit 511 arranged by the drive of the humidification pump 510 for

hydrogen to predetermined timing at a reformer 3 is sent to the entrance side 512 of a fuel cell 6.
[0052] Thus, it can change and moisture can be maintained at homogeneity by this, and after every fixed time amount, the amount generating of fixed currents, and fixed electric-energy generating, timing of this exchange is performed for whenever [of every or starting/halt / every], whenever [according to / the drive of the pump 500 for air, and the humidification pump 510 for water] a load is set to 0 (or below constant value). Exchange of this air is performed by actuation of a bulb 503,504, and exchange of hydrogen is performed by actuation of a bulb 513,514.
[0053]
[Effect of the Invention] The cel stack constituted by invention according to claim 1 carrying out the laminating of the electrode substrate with which a fuel cell consists of ion exchange membrane, a forward catalyst electrode, and a negative catalyst electrode as described above, While consisting of the water storage section which absorbs the water in an electrode substrate at the time of the overwater of an electrode substrate, and supplies water to an electrode substrate at the time of the water shortage of an electrode substrate, approaching an electrode substrate and arranging the water storage section Water is continued and supplied to the water storage section from the exterior of a cel stack immediately after a generation-of-electrical-energy halt of a fuel cell. Since water is kept in the water storage section, it constitutes so that the water of the water storage section may be supplied to an electrode substrate at the time of starting of a fuel cell, and the water of the water storage section is supplied at the time of starting and the water storage section goes up at the almost same temperature as a cel at the time of starting, Compared with what supplies water, exact humidity management can be performed from the exterior at the time of starting. Moreover, since water can be kept in the condition of having contained the interior or near the cel, at the time of a generation-of-electrical-energy halt, it is possible to maintain the humidity of the ion exchange membrane of a cel at a saturation state mostly also during storage.
[0054] Furthermore, supply control of the water of a fuel cell is easy, and the supply of the water corresponding to a load effect of it is attained at the time of a generation of electrical energy. Moreover, since the amount of supply of water can be made into the minimum which needs a cel, the miniaturization of reduction of the amount of the water used, reduction of pump power required for water supply, reduction of the amount of heating, the evaporation section, a heat exchanger, etc. and the miniaturization of a water tank are possible, and efficient and small lightweight-ization are attained.
[0055] Since the water of condensation and superfluous water are securable at the time of starting, the amount of supply of humidification water can be reduced. Moreover, during starting, since the water which is not contributed to humidification is removed from a gas passageway, the engine performance is highly maintainable from generation-of-electrical-energy initiation.
[0056] Moreover, supply control of the water of a fuel cell is easy, and the supply of the water corresponding to a load effect of it is attained at the time of a generation of electrical energy. Moreover, since the amount of supply of water can

be made into the minimum which needs a cel, the miniaturization of reduction of the amount of the water used, reduction of pump power required for water supply, reduction of the amount of heating, the evaporation section, a heat exchanger, etc. and the miniaturization of a water tank are possible, and efficient and small lightweight-ization are attained.

[Translation done.]

TECHNICAL FIELD

[Field of the Invention] This invention relates to the fuel cell system which reforms a raw material, manufactures hydrogen and generates electricity by supplying the obtained hydrogen to a fuel cell.

[Translation done.]

PRIOR ART

[Description of the Prior Art] As a fuel cell system, an evaporator is heated with a heater, by the reformer which supplied the raw material evaporated with this evaporator to the catalyst bed, a raw material is reformed, hydrogen is manufactured, and there are some which generate electricity by supplying the obtained hydrogen to a fuel cell.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] The cel stack constituted by invention according to claim 1 carrying out the laminating of the electrode substrate with which a fuel cell consists of ion exchange membrane, a forward catalyst electrode, and a negative catalyst electrode as described above, While consisting of the water storage section which absorbs the water in an electrode substrate at the time of the overwater of an electrode substrate, and supplies water to an electrode substrate at the time of the water shortage of an electrode substrate, approaching an electrode substrate and arranging the water storage section Water is continued and supplied to the water storage section from the exterior of a cel stack immediately after a generation-of-electrical-energy halt of a fuel cell. Since water is kept in the water storage section, it constitutes so that the water of the water storage section may be supplied to an electrode substrate at the time of starting of a fuel cell, and the water of the water storage section is supplied at the time of starting and the water storage section goes up at the almost same temperature as a cel at the time of starting, Compared with what supplies water, exact humidity management can be performed from the exterior at the time of starting. Moreover, since water can be kept in the condition of having contained the interior or near the cel, at the time of a generation-of-electrical-energy halt, it is possible to maintain the humidity of the ion exchange membrane of a cel at a saturation state mostly also during storage.
[0054] Furthermore, supply control of the water of a fuel cell is easy, and the supply of the water corresponding to a load effect of it is attained at the time of a generation of electrical energy. Moreover, since the amount of supply of water can be made into the minimum which needs a cel, the miniaturization of reduction of the amount of the water used, reduction of pump power required for water supply, reduction of the amount of heating, the evaporation section, a heat exchanger, etc. and the miniaturization of a water tank are possible, and efficient and small lightweight-ization are attained.
[0055] Since the water of condensation and superfluous water are securable at the time of starting, the amount of supply of humidification water can be reduced. Moreover, during starting, since the water which is not contributed to humidification is removed from a gas passageway, the engine performance is highly maintainable from generation-of-electrical-energy initiation.
[0056] Moreover, supply control of the water of a fuel cell is easy, and the supply

of the water corresponding to a load effect of it is attained at the time of a generation of electrical energy. Moreover, since the amount of supply of water can be made into the minimum which needs a cel, the miniaturization of reduction of the amount of the water used, reduction of pump power required for water supply, reduction of the amount of heating, the evaporation section, a heat exchanger, etc. and the miniaturization of a water tank are possible, and efficient and small lightweight-ization are attained.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] In a fuel cell, it serves as overwater feeling, and a water shortage and generation-of-electrical-energy termination to a halt serves as overwater feeling from starting by the steady state to a stationary. For this reason, the complicated water supply control doubled with each operation mode was required. Even if the surrounding humidity of the ion exchange membrane accompanying the temperature rise of the cel of a fuel cell was large and supplied water from the exterior, since the cel of a fuel cell had got cold, the steam condensed to the gas passageway on the way especially at the time of starting, and it was not fully able to humidify ion exchange membrane of an electrode substrate.
[0004] Thus, the engine performance of the cel of a fuel cell deteriorated, and that humidity control is difficult had also become the cause that the cel engine performance could not fully be taken out in early stages of a generation of electrical energy.
[0005] Moreover, a lot of water was needed and bad influences, such as gas-passageway lock out by it, were also generated.
[0006] Moreover, when it uses for migration, the amount of supply of the water needed for the cel of a fuel cell is violently changed with a load level, cel temperature, etc. On the other hand, the amount of humidification cannot be equivalent to the speed of the change. Therefore, it was difficult to control the amount of humidification proper.
[0007] Furthermore, when water was supplied by the peak price of fluctuation so that humidifying might not become insufficient, it became hydration, and diffusion paths of gas, such as pore of the carbon paper which is an electrode substrate, were got blocked with water, and there was a problem that the engine performance of a cel fell. Moreover, when water was supplied by the average in consideration of fluctuation of water, the excess and deficiency of supply will be repeated and the engine performance of a cel was not fully able to be taken out.
[0008] This invention was made in view of this point, and aims at offering the fuel cell system which can maintain the engine performance of the cel of a fuel cell also by operational status, such as starting and a halt.

[Translation done.]

MEANS

[Means for Solving the Problem] In order to solve said technical problem and to attain the purpose, invention according to claim 1 In the fuel cell system which generates electricity by supplying the air containing hydrogen and oxygen to the cel of a fuel cell The cel stack constituted by said fuel cell carrying out the laminating of the electrode substrate which consists of ion exchange membrane, a forward catalyst electrode, and a negative catalyst electrode, While consisting of the water storage section which absorbs the water in said electrode substrate at the time of the overwater of said electrode substrate, and supplies water to said electrode substrate at the time of the water shortage of said electrode substrate, approaching said electrode substrate and arranging said water storage section Water is continued and supplied to said water storage section from the exterior of said cel stack immediately after a generation-of-electrical-energy halt of said fuel cell, water is kept in said water storage section, and it is characterized by constituting so that the water of said water storage section may be supplied to said electrode substrate at the time of starting of said fuel cell.
[0010] Thus, by supplying the water of the water storage section at the time of starting, at the time of starting, since the water storage section goes up at the almost same temperature as a cel, compared with what supplies water, exact humidity management can be performed from the exterior. Moreover, since water can be kept in the condition of having contained the interior or near the cel, at the time of a halt, it is possible to maintain the humidity of the electrode substrate of a cel at a saturation state mostly also during storage.
[0011] Furthermore, supply control of the water of a fuel cell is easy, and the supply of the water corresponding to a load effect of it is attained at the time of a generation of electrical energy. Moreover, since the amount of supply of water can be made into the minimum which needs a cel, the miniaturization of reduction of the amount of the water used, reduction of pump power required for water supply, reduction of the amount of heating, the evaporation section, a heat exchanger, etc. and the miniaturization of a water tank are possible, and efficient and small lightweight-ization are attained.
[0012] Furthermore, supply control of the water of a fuel cell is easy, and the supply of the water corresponding to a load effect of it is attained at the time of a generation of electrical energy. Moreover, since the amount of supply of water can be made into the minimum which needs a cel, the miniaturization of reduction of

the amount of the water used, reduction of pump power required for water supply, reduction of the amount of heating, the evaporation section, a heat exchanger, etc. and the miniaturization of a water tank are possible, and efficient and small lightweight-ization are attained.

[0013]

[Embodiment of the Invention] Hereafter, the example of the fuel cell system of this invention is explained to a detail based on a drawing.

[0014] Drawing 1 is the block diagram showing the example of a fuel cell system.

[0015] An electric vehicle is equipped with the fuel cell system 1, and it has some which run the electrical and electric equipment generated with a fuel cell as a driving source. This fuel cell system 1 consists of the methanol tank 2, a reformer 3, a shift converter 4, the selective oxidation reactor 5, the fuel cell 6, a moisture recuperator 7, a water tank 8, and controller 9 grade. The controller 9 is connected with each device, such as a bulb, a pump, and a fan, and a sensor. Each part of a reformer 3, a shift converter 4, the selective oxidation reactor 5, and a fuel cell 6 is equipped with temperature sensors Tr, Tb, Ts, Tp, and Tc, and each part is controlled by these temperature detection by proper temperature by the controller 9.

[0016] The reformer 3 is equipped with the heater 10, the evaporator 11, and the catalyst bed 12 grade. In a heater 10, the burner pump 13 drives by temperature detection of temperature sensor Tb, and a methanol is supplied from the methanol tank 2 to it, and air is supplied by drive of the burner fan 14 to it, it burns in these in it, and an evaporator 11 is heated to it. By the drive of the methanol pump 15, with the methanol supplied from the methanol tank 2, the water supplied from a water tank 8 by the drive of a water pump 16 is mixed in an evaporator 11, and it is supplied again. The fuel which heated the evaporator 11 with the heater 10, evaporated the composite fuel of a methanol and water, and was evaporated with this evaporator 11 is supplied to a catalyst bed 12.

[0017] By this reformer 3, a raw material is reformed, hydrogen is manufactured, and the hydrogen obtained by temperature detection of a temperature sensor Tr is supplied to a fuel cell 6 through a shift converter 4 and the selective oxidation reactor 5. A change-over valve 17 is formed between a reformer 3 and a shift converter 4, and hydrogen is returned to the heater 10 of a reformer 3 by actuation of this change-over valve 17. A shift converter 4 is cooled by temperature detection of a temperature sensor Ts by the air fan 18 for cooling. The air supplied by the drive of the air pump 19 for a reaction is mixed in the hydrogen sent from a shift converter 4, and it is supplied at the selective oxidation reactor 5. The selective oxidation reactor 5 is cooled by temperature detection of a temperature sensor Tp by the air fan 20 for cooling. A change-over valve 21 is formed between the selective oxidation reactor 5 and a fuel cell 6, and hydrogen is returned to the heater 10 of a reformer 3 by actuation of this change-over valve 21.

[0018] To a fuel cell 6, water is supplied from a water tank 8 by the drive of the cooling humidification pump 22, and air is supplied by temperature detection of temperature sensor Tc from the moisture recuperator 7 by the drive of the pressurization air pump 23 to it, and it generates electricity from these water, air,

and hydrogen with a fuel cell 6 to it. The water used with the fuel cell 6 obtains water by heat exchange with the moisture recuperator 7, and is returned to a water tank 8. Moreover, the hydrogen used with the fuel cell 6 for the generation of electrical energy is returned to the heater 10 of a reformer 3.

[0019] By the reformer 3 which supplied the raw material which heated the evaporator 11 and was evaporated with this evaporator 11 with the heater 10 to the catalyst bed 12 in the fuel cell system 1 A raw material is reformed, hydrogen is manufactured and it generates electricity by supplying the obtained hydrogen to a fuel cell 6 through a shift converter 4 and the selective oxidation reactor 5. A reformer 3 A part of reactant gas by fuel reforming is taken out from the middle of a catalyst bed 12, and it constitutes so that it may return to a heater 10 through the return system 30. The return system 30 consists of piping 32 which connects the reactant gas fetch section 31 prepared in the catalyst bed 12 side, this reactant gas fetch section 31, and a heater 10 side, and a bulb 33 with which this piping 32 was equipped, takes out a part of reactant gas by fuel reforming from a catalyst bed 12 by opening a bulb 33, and is returned to a heater 10. As for a bulb 33, an ON/OFF bulb or a positive crankcase ventilation valve is used.

[0020] Next, the concrete example of a fuel cell is explained based on drawing 2 thru/or drawing 4 . The sectional view where drawing 2 meets the front view of a fuel cell, and drawing 3 meets the III-III line of drawing 2 , and drawing 4 are sectional views which meet X-X-ray and the Y-Y line of drawing 2 .

[0021] The fuel cell 6 is equipped with the cel stack 103 attached by ****** 102. The cel stack 103 is carried out for constructing Separators 104a, 104b, and 104c, two or more laminatings of it are carried out, it is attached, and is constituted, and 104d of gas cutoff plates is formed between separator 104a and separator 104c. Tunnel path 115b is formed between 104d of gas cutoff plates at separator 104c. Among Separators 104a and 104b, it has the cel 106. The electrode substrate B of a cel 106 consists of ion exchange membrane 107, a forward catalyst electrode 108, and a negative catalyst electrode 109. Periphery section 107a of ion exchange membrane 107 is inserted and held among Separators 104a and 104b, it has the catalyst electrode 108 of ion exchange membrane 107 forward to a field on the other hand, has the negative catalyst electrode 109 in the another side side, makes the hydrogen and oxygen of reactant gas react by this cel 106, generates water, and generates the electrical and electric equipment in that case.

[0022] The porous guide object 110 formed in the outside of the forward catalyst electrode 108 of a cel 106 by the porous member is contacted, and it is arranged, and the porous guide object 111 formed also in the outside of the negative catalyst electrode 109 by the porous member is contacted, it is arranged, and the water storage section A for the absorption at the time of overwater and the supply at the time of a water shortage on the outside of an electrode substrate consists of porous members.

[0023] The porous guide object 110,111 is fabricated by the porosity porous member, and Slots 110a and 111a are formed in the whole surface side at equal intervals, respectively. The porous guide object 110 contacts the side in which slot 110a was formed to the forward catalyst electrode 108, and the porous guide object 111 is arranged towards the direction which intersects slot 111a

perpendicularly with slot 110a of the porous guide object 110. The reactant gas path 112 which is open for free passage between slot 110a of the porous guide object 110 and the forward catalyst electrode 108 is formed, and the reactant gas path 113 which is open for free passage between slot 111a of the porous guide object 111 and the negative catalyst electrode 109 is formed.

[0024] A cel 106 does the include-angle alpha inclination of, and is arranged, a gasket 114 is formed among the separators 104b and 104c surrounding the perimeter of a cel 106, and the seal of the cel 106 is carried out to the cel stack 103 with the gasket 114. The inlet-port section 115 of hydrogen is formed in the left-hand side upper part of the cel stack 103, the outlet section 116 of hydrogen is formed in a right-hand side lower part, a gasket 117,118 is formed among Separators 104a and 104b so that the perimeter of the inlet-port section 115 and the outlet section 116 may be surrounded, and the seal of the inlet-port section 115 and the outlet section 116 is carried out. Inlet-port path 115a is formed in the direction of a laminating of a cel 106 at the inlet-port section 115, four tunnel paths 115b is open for free passage from this inlet-port path 115a to distribution path 115c of a cel 106 through the lower part of a gasket 114, and it is open for free passage from distribution path 115c to the reactant gas path 113. In the outlet section 116, outlet path 116a is formed in the direction of a laminating of a cel 106, four tunnel paths 116b opened for free passage by this outlet path 116a is open for free passage to set path 116c of a cel 106 through the lower part of a gasket 114, and set path 116c is open for free passage with the reactant gas path 113.

[0025] The inlet-port section 119 of oxygen is formed in the upper part right-hand side of the cel stack 103, the outlet section 120 of oxygen is formed in lower part left-hand side, a gasket 121,122 is formed among Separators 104a and 104b so that the perimeter of the inlet-port section 119 and the outlet section 120 may be surrounded, and the seal of the inlet-port section 119 and the outlet section 120 is carried out. Inlet-port path 119a is formed in the direction of a laminating of a cel 106 at the inlet-port section 119, four tunnel paths 119b is open for free passage from this inlet-port path 119a to distribution path 119c of a cel 106 through the lower part of a gasket 114, and it is open for free passage from distribution path 119c to the reactant gas path 112. In the outlet section 120, outlet path 120a is formed in the direction of a laminating of a cel 106, four tunnel paths 120b opened for free passage by this outlet path 120a is open for free passage to set path 120c of a cel 106 through the lower part of a gasket 114, and set path 120c is open for free passage with the reactant gas path 112.

[0026] Moreover, the water path 123 is formed in the contact section with the porous guide object 110 which is an inferior surface of tongue in drawing 3 of 104d of gas cutoff plates. The discharge section 124 prepared in the bottom near the inlet-port section 115 of hydrogen through tunnel path of water path 123 where 123a passes along lower part of gasket 114 on the other hand 124a is open for free passage, and another side 123b is opened for free passage by the feed zone 125 prepared in the bottom near the outlet section 116 of hydrogen through tunnel path 125a which passes along the lower part of a gasket 114. Gaskets 126a and 127a are formed among Separators 104a and 104c so that the perimeter of the

discharge section 124 and a feed zone 125 may be surrounded, and the seal of the discharge section 124 and the feed zone 125 is carried out.
[0027] Moreover, the water path 128 is formed in the contact section with the porous guide object 110 which is a top face in drawing 3 of separator 104b. The discharge section 129 prepared in right-hand side near the inlet-port section 119 of oxygen through tunnel path of water path 128 where 128a passes along lower part of gasket 114 on the other hand 129a is open for free passage, and another side 128b is opened for free passage by the feed zone 130 prepared in left-hand side near the outlet section 120 of oxygen through tunnel path 130a which passes along the lower part of a gasket 114. Gaskets 126b and 127b are formed among Separators 104a and 104b so that the perimeter of the discharge section 129 and a feed zone 130 may be surrounded, and the seal of the discharge section 129 and the feed zone 130 is carried out.
[0028] Therefore, if the hydrogen warmed and humidified is supplied from the inlet-port section 115 of the hydrogen of the cel stack 103, the hydrogen containing this moisture will be led to distribution path 115c of a cel 106 through inlet-port path 115a to tunnel path 115b, and will flow the reactant gas path 113 from distribution path 115c. On the other hand, if the oxygen warmed and humidified is supplied from the inlet-port section 119 of oxygen, the oxygen containing this moisture will be open for free passage to distribution path 119c of a cel 106 through inlet-port path 119a to tunnel path 119b, and will flow the reactant gas path 112 from distribution path 119c.
[0029] At this time, by the cel 106, water is generated and the generation of electrical energy which takes out change of the free energy in that case as electrical energy is performed by the electrochemical reaction of the hydrogen and oxygen of reactant gas. A cel 106 is connected at the cel 106 and serial which adjoined through separator 104c, and the generated power is taken out from the current collection section which is not illustrated [which was prepared in the both ends of the cel stack 103].
[0030] Hydrogen and water are brought together in set path 116c of a cel 106, are led to outlet path 116a through tunnel path 116b, and are mainly discharged from the outlet section 116. Oxygen and water are brought together in set path 120c of a cel 106, are led to outlet path 120a through tunnel path 120b, and are mainly discharged from the outlet section 120.
[0031] a cel -- 106 -- depending -- hydrogen -- oxygen -- being electrochemical -- a reaction -- one side -- **** -- oxygen -- water -- porous one -- a guide -- the body -- 110 -- forward -- a catalyst -- an electrode -- 108 -- a passage -- ion exchange membrane -- 107 -- a front face -- supplying -- having -- another side -- **** -- hydrogen -- water -- porous one -- a guide -- the body -- 111 -- negative -- a catalyst -- an electrode -- 109 -- a passage -- ion exchange membrane -- 107 -- a front face -- supplying -- having -- this -- forward -- a catalyst -- an electrode -- 108 -- ion exchange membrane -- 107 -- an interface -- and -- negative -- a catalyst -- an electrode -- 109 -- ion exchange membrane -- 107 -- an interface -- carrying out -- having -- . Since elongation changes with water content a lot, ion exchange membrane 107 needs to always keep proper the humidification level of ion exchange membrane 107, to keep the

elongation of ion exchange membrane 107 constant, and to maintain an interface at stability.
[0032] Although the electrical and electric equipment occurs at the electrochemical reaction of the hydrogen and oxygen of the reactant gas by this cel 106 and water is generated in that case Although the engine performance of elongation and a cel 106 will deteriorate further if superfluous water, such as the water of condensation generated not only in the elongation by the relative humidity of this cel 106 interior but in the interior, generation water, and oversupply water, contacts ion exchange membrane 107 directly The porous guide object 110,111 was contacted to the catalyst electrode 108,109 of the both sides of a cel 106, and it arranges, and superfluous water, such as the water of condensation generated in the cel 106 interior, generation water, and oversupply water, can be absorbed with the porous guide object 110,111, and can be removed.
[0033] For this reason, the elongation of ion exchange membrane 107 could be prevented, and the engine performance of a cel 106 could be kept efficient for a long period of time, and the diffusibility fall of reactant gas is prevented. Thus, superfluous water can be removed without using special equipment, and it can consider as simplicity, a low price, a compact, and lightweight equipment. When supplying water by forming the reactant gas path 112,113 with the porous guide object 110,111, it is absorbed with the porous guide object 110,111, and a part is diffused to the reactant gas path 112,113, while humidifying effectively by moving to the direct catalyst electrode 108,109, when superfluous water is generated, a part has the damper effectiveness which absorbs this and is supplied at the time of lack, and humidification of optimum dose is possible for it.
[0034] Moreover, the water storage section A for the absorption at the time of overwater and the supply at the time of a water shortage on the outside of the electrode substrate which consists of ion exchange membrane 107, a forward catalyst electrode 108, and a negative catalyst electrode 109 is formed in the cel stack 103 interior of a fuel cell 6, and water is kept in the water storage section A at the time of a halt, and it constitutes so that the water of the water storage section A may be supplied at the time of starting.
[0035] Thus, by supplying the water of the water storage section A at the time of starting of a fuel cell, at the time of starting, since the water storage section A goes up at the almost same temperature as a cel 106, compared with what supplies water, exact humidity management can be performed from the exterior. Moreover, since water can be kept in the water storage section A in the condition of having contained the interior or near the cel 106, at the time of a halt, it is possible to maintain mostly the humidity of the ion exchange membrane 107 of a cel 106 at a saturation state also during storage.
[0036] Furthermore, supply control of the water of a fuel cell 6 is easy, and the supply of the water corresponding to a load effect of it is attained at the time of a generation of electrical energy. Moreover, since the amount of supply of water can be made into the minimum which needs a cel 106, the miniaturization of reduction of the amount of the water used, reduction of pump power required for water supply, reduction of the amount of heating, the evaporation section, a heat exchanger, etc. and the miniaturization of a water tank are possible, and efficient

and small lightweight-ization are attained.
[0037] Moreover, water is kept in the water storage section A at the time of starting, and it constitutes so that the water of the water storage section A may be supplied at the time of a stationary. Thus, by supplying the water of the water storage section A at the time of a stationary, at the time of starting, the water of condensation and superfluous water can be secured and the amount of supply of humidification water can be reduced. Moreover, during starting, since the water which is not contributed to humidification is removed from a gas passageway, the engine performance is highly maintainable from generation-of-electrical-energy initiation.
[0038] Furthermore, supply control of the water of a fuel cell 6 is easy, and the supply of the water corresponding to a load effect of it is attained at the time of a generation of electrical energy. Moreover, since the amount of supply of water can be made into the minimum which needs a cel, the miniaturization of reduction of the amount of the water used, reduction of pump power required for water supply, reduction of the amount of heating, the evaporation section, a heat exchanger, etc. and the miniaturization of a water tank are possible, and efficient and small lightweight-ization are attained.
[0039] Drawing 5 thru/or drawing 8 show other examples of the water storage section. The water storage section A of drawing 5 has multilayer structure, the 1st storage section A1 is formed by the porous member which has a path 300, and the 2nd storage section A2 is similarly formed by the porous member. Although water is absorbed and held from the path 300 of the 1st storage section A1 at the 2nd storage section A2, from the 2nd storage section A2, the 1st storage section A1 has good water absorption, and has increased water capacity by making the water storage section A into multilayer structure.
[0040] The water storage section A of drawing 6 has multilayer structure, the 1st storage section A1 is formed by the porous member which has a path 300 similarly, and the 2nd storage section A2 is formed by the porous member or non-permeated material. It has the crevice in the 1st storage section A1 side of the 2nd storage section A2, space is formed between this crevice and the 1st storage section A1, and the path 301 is formed in this space. Although water is absorbed and held from the path 300 of the 1st storage section A1 at the 2nd storage section A2, water is further held so much and certainly by the path 301.
[0041] Although the water storage section A of drawing 7 has multilayer structure, the 1st storage section A1 is formed by the porous member which has a path 300 and the 2nd storage section A2 is similarly formed by the porous member, the non-permeated material C is arranged on the outside of this 2nd storage section A2. Between paths 300, the guide path 302 which opens the outside and the 2nd storage section A2 of an electrode substrate B for free passage is formed at the 1st storage section A1. Moreover, the water path 303 is formed in the 2nd storage section A2 between the non-permeated material C. Therefore, by lengthening with negative pressure, water is absorbed by the 1st storage section A1 from a path 300, it is further absorbed by the guide path 302 at the 2nd storage section A2, and water absorption is quick.
[0042] The water storage section A of drawing 8 has multilayer structure, the 1st

storage section A1 is formed by the porous member which has a path 300, and the non-permeated material C is arranged on the outside of this 1st storage section A1. The water path 304 is formed between the 1st storage sections A1, and water is smoothly supplied to the non-permeated material C from the water path 304 at the 1st storage section A1.

[0043] Drawing 9 and drawing 10 show the arrangement location of the water storage section A. In the example of drawing 9 , the gas passageway 400 is formed in the both sides of the cel 106 which consists of electrode substrates, and the water storage section A is formed in the space of this gas passageway 400. Thus, it is arranged in the location where the water storage section A separated from the cel 106 of an electrode substrate, and the water supplied with a water pump 401 is kept by the water storage section A.

[0044] In the example of drawing 10 , the inlet-port section 115 of hydrogen and the outlet section 116 of hydrogen are formed in the both sides of the cel 106 which consists of electrode substrates. Inlet-port path 115a is formed in the direction of a laminating of a cel 106 at the inlet-port section 115, four tunnel paths 115b is opened for free passage by distribution path 115c of a cel 106 from this inlet-port path 115a, and the water storage section A is formed in this entrance side.

[0045] Moreover, outlet path 116a is formed in the direction of a laminating of a cel 106 at the outlet section 116, four tunnel paths 116b is opened for free passage by set path 116c of a cel 106 from this outlet path 116a, and the water storage section A is formed in this outlet side.

[0046] Next, operation of a fuel cell system is explained based on drawing 11 . In drawing 11 (a), characteristic curves b1 and c1 show this invention for operation of the former [characteristic curve / a1], respectively. Moreover, in drawing 11 (b), characteristic curves b2 and c2 show this invention for operation of the former [characteristic curve / a2], respectively.

[0047] In the conventional thing, supply of the steam to a fuel cell is gradually suspended immediately after halt actuation of a fuel cell system at the time of a halt. The humidity inside a cel changes with surrounding temperature at the time of storage. If temperature approaches saturated humidity gradually by fall and exceeds it, moisture condenses and a path etc. is blockaded. Moreover, since the water of condensation is unevenly distributed even if temperature rises, there is little humidification effectiveness to the film of an electrode substrate. The preparations (a pump is driven and a steam is made by heating or heat exchange.) for supplying water (or steam) from the exterior in advance of generation-of-electrical-energy initiation at the time of starting are made. While raising the temperature of a cel to proper temperature with generation-of-electrical-energy initiation, water (or steam) is supplied from the exterior. Since it is necessary to change the moisture amount of supply at the time of a generation of electrical energy according to the temperature of an output and a cel etc., there is a problem of having to change the amount of humidification frequently.

[0048] Supply of the steam(water) from the outside of a fuel cell is not suspended at the time of a generation-of-electrical-energy halt of a fuel cell, but it is the same as the time of a generation of electrical energy, or sending the flow rate

beyond it is continued, and the water storage section A is made to absorb as water in the example of drawing 11 (b) which is the fuel cell system 1 of this invention. In the time of storage, it is maintained at the saturated humidity by surrounding temperature, and a condensed part is absorbed further. The temperature of a cel 106 is raised to proper temperature with generation-of-electrical-energy initiation at the time of starting. Heat tracing or self-generation of heat is used for this. In early stages, water (or steam) supply from the outside is not performed, but the water of the water storage section A is used. Temperature rises with the rise of cel temperature and the water of the water storage section A evaporates to the gas passageway. Thereby, a gas passageway is maintained near the saturated humidity. Only by humidification by natural evaporation of storage water, since there is a limitation in time, in order to shorten warm-up time, water (or steam) is supplied from the exterior after fixed time amount progress. Since absorption and emission efficiency of moisture can be used at the time of a generation of electrical energy, even if it does not change the amount of humidification frequently, proper humidification control is possible.

[0049] Moreover, in the example of drawing 11 (c), supply of water (steam) is gradually suspended immediately after halt actuation of a system at the time of a halt. It is maintained at the saturated humidity by surrounding temperature in the time of storage. A condensed part is absorbed further. The preparations (a pump is driven and a steam is made by heating or heat exchange.) for supplying water (or steam) from the exterior in advance of generation-of-electrical-energy initiation at the time of starting are made. While raising the temperature of a cel to proper temperature with generation-of-electrical-energy initiation, water (or steam) is supplied from the exterior. Since some water of the water storage section A can be used, in early stages, water (or steam) supply from the outside is not performed, but the water of the water storage section A is used. Therefore, there is little water amount of supply compared with the former, and it ends. Supplying water, water is kept in the water storage section A, and it uses for humidity management later. Since absorption and emission efficiency of moisture can be used at the time of a generation of electrical energy, even if it does not change the amount of humidification frequently, proper humidification control is possible.

[0050] Drawing 12 is the block diagram showing other examples of a fuel cell system. Although constituted like drawing 1 , the fuel cell 6 of this example is constituted so that the air heated by delivery and this heating unit 501 in air from the water tank 8 by the heating unit 501 which is arranged by the drive of the pump 500 for air at a reformer 3 unlike drawing 1 may be sent to the entrance side 502 of a fuel cell 6. Moreover, it is constituted so that the water heated by delivery and this heating unit 511 in water from the water tank 8 by the heating unit 511 arranged by the drive of the humidification pump 510 for water at a reformer 3 may be sent to the entrance side 512 of a fuel cell 6.

[0051] a fuel cell 6 -- a hydrogen side -- an inlet port -- moisture -- many -- moreover, an air side -- an outlet -- moisture -- it becomes [many]. For this reason, the air heated by delivery and this heating unit 501 by the heating unit 501 arranged by the drive of the pump 500 for air to predetermined timing at a reformer 3 is sent to the entrance side 502 of a fuel cell 6. Moreover, the hydrogen

heated by delivery and this heating unit 511 in hydrogen from the water tank 8 by the heating unit 511 arranged by the drive of the humidification pump 510 for hydrogen to predetermined timing at a reformer 3 is sent to the entrance side 512 of a fuel cell 6.

[0052] Thus, it can change and moisture can be maintained at homogeneity by this, and after every fixed time amount, the amount generating of fixed currents, and fixed electric-energy generating, timing of this exchange is performed for whenever [of every or starting/halt / every], whenever [according to / the drive of the pump 500 for air, and the humidification pump 510 for water] a load is set to 0 (or below constant value). Exchange of this air is performed by actuation of a bulb 503,504, and exchange of hydrogen is performed by actuation of a bulb 513,514.

[Translation done.]

DESCRIPTION OF DRAWINGS

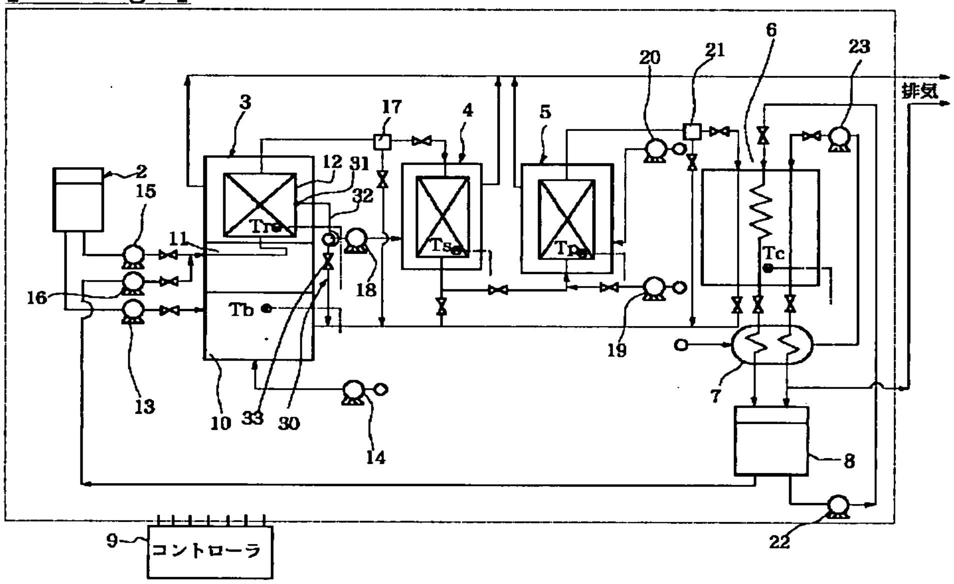
[Brief Description of the Drawings]
[Drawing 1] It is the block diagram showing the example of a fuel cell system.
[Drawing 2] It is the front view of a fuel cell.
[Drawing 3] It is the sectional view which meets the III-III line of drawing 2 .
[Drawing 4] It is the sectional view which meets X-X-ray and the Y-Y line of drawing 2 .
[Drawing 5] It is drawing showing other examples of the water storage section.
[Drawing 6] It is drawing showing other examples of the water storage section.
[Drawing 7] It is drawing showing other examples of the water storage section.
[Drawing 8] It is drawing showing other examples of the water storage section.
[Drawing 9] It is drawing showing other examples which show arrangement of the water storage section.
[Drawing 10] It is drawing showing other examples which show arrangement of the water storage section.
[Drawing 11] It is ** explaining operation of a fuel cell system.
[Drawing 12] It is the block diagram showing other examples of a fuel cell system.
[Description of Notations]
1 Fuel Cell System
6 Fuel Cell
103 Cel Stack
106 Fuel Cell Cel
107 Ion Exchange Membrane
108 Forward Catalyst Electrode
109 Negative Catalyst Electrode
B Electrode substrate
A Water storage section

[Translation done.]

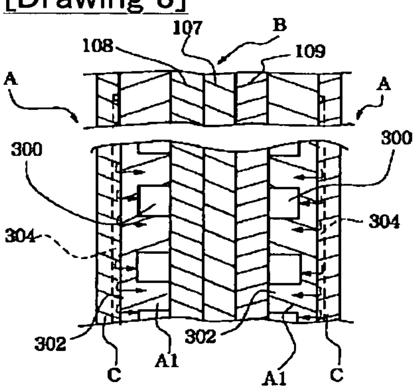
* NOTICES *

DRAWINGS

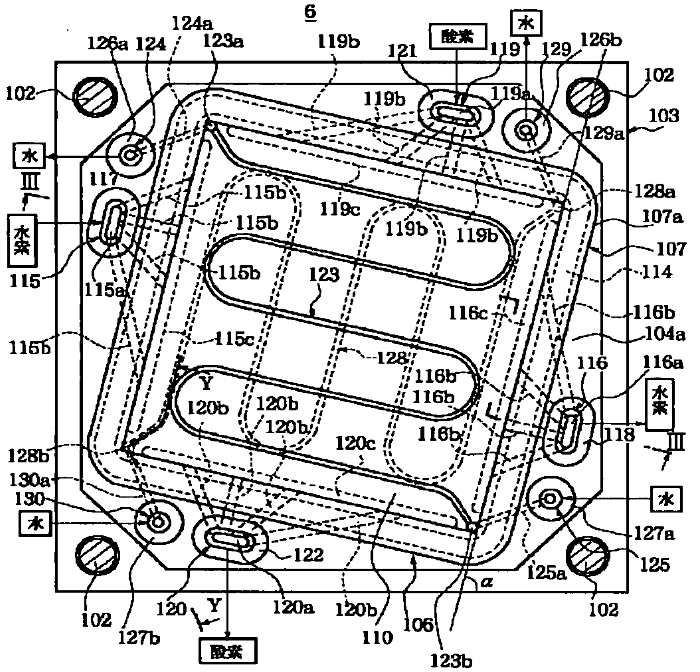
[Drawing 1]



[Drawing 8]



[Drawing 2]



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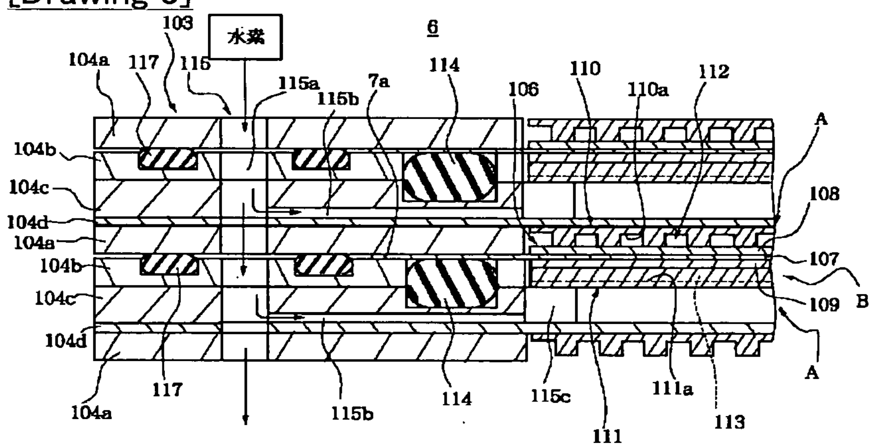
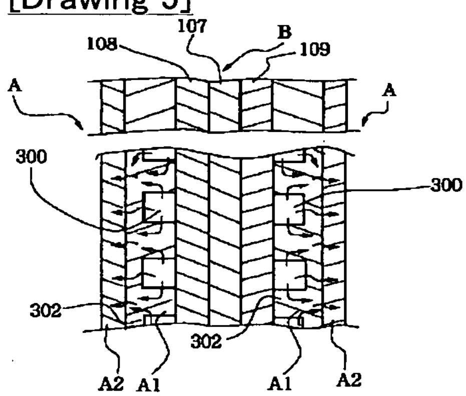
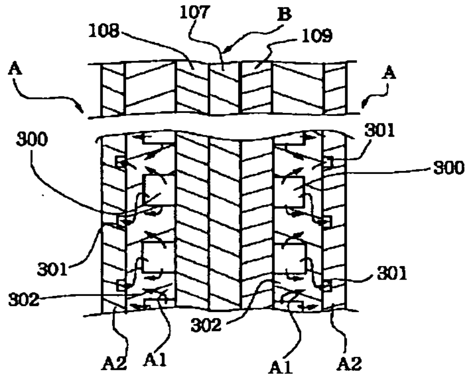


[Drawing 5]



[Drawing 6]



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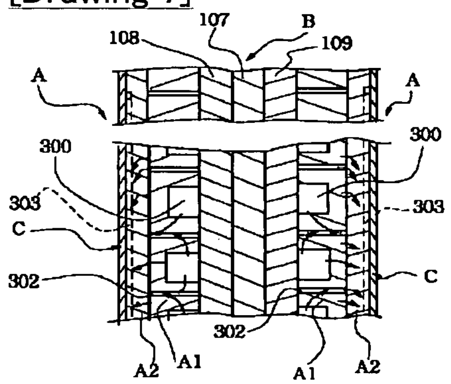
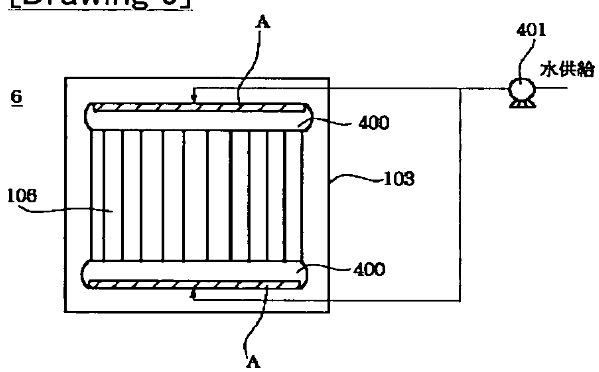
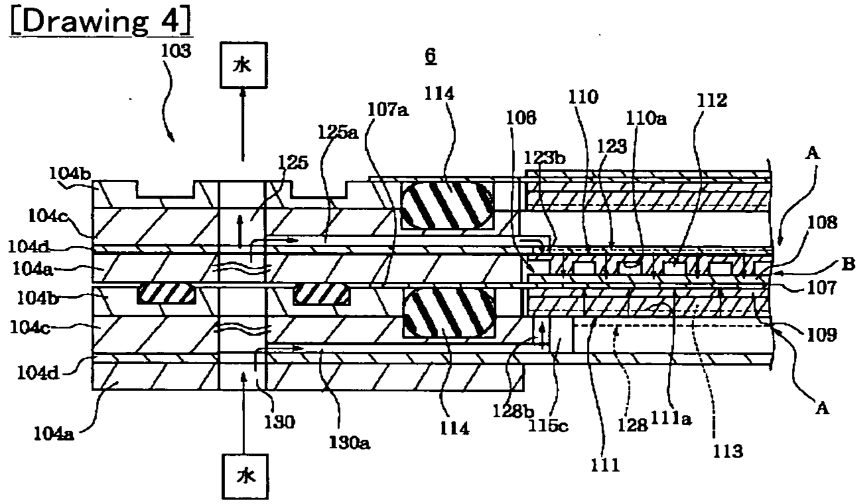


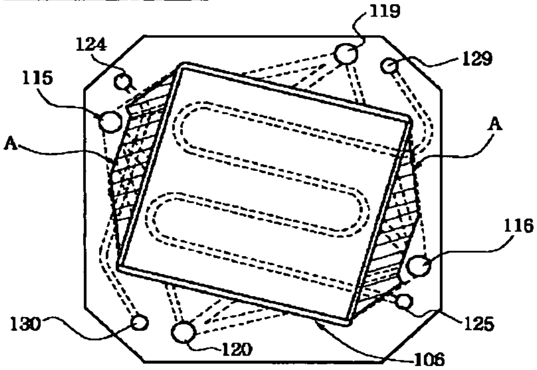
[Drawing 9]



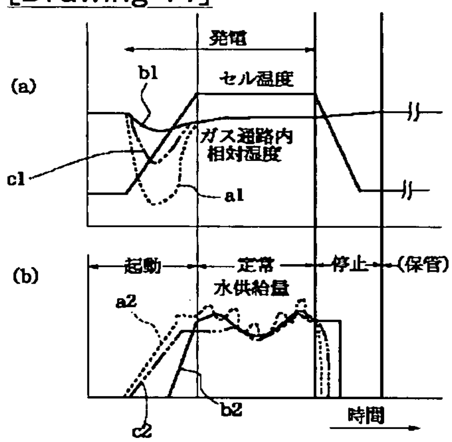
[Drawing 4]



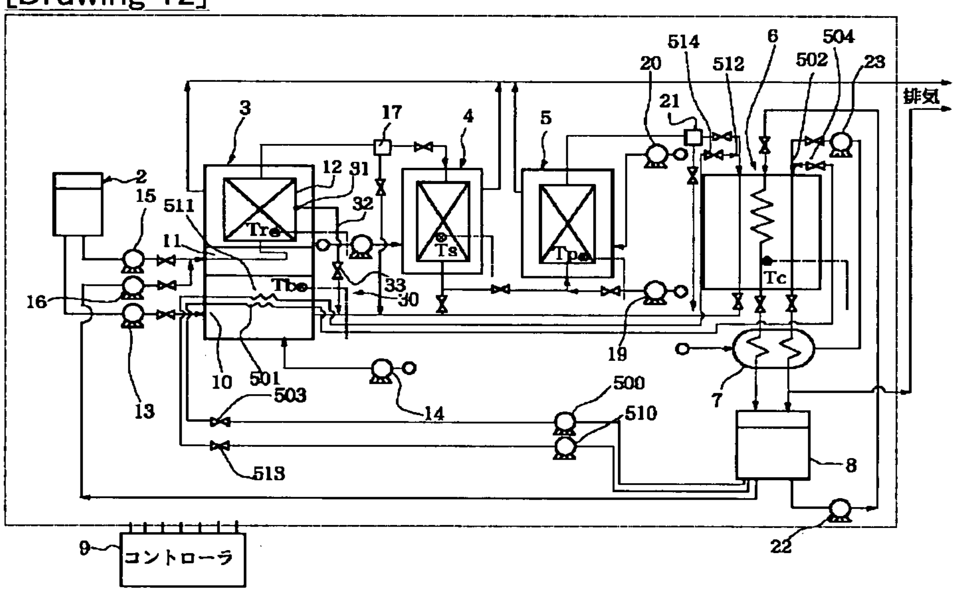
[Drawing 10]



[Drawing 11]



[Drawing 12]



[Translation done.]

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			Ｘ　５Ｈ０２７
			Ｙ
8/10		8/10	

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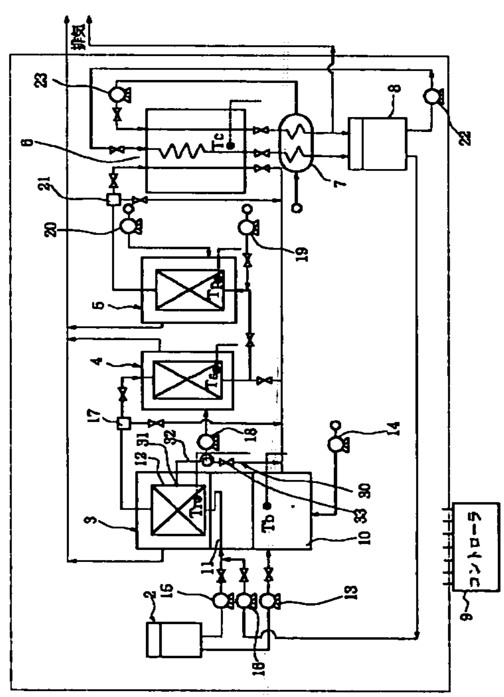
Ｆターム（参考）　5H026 AA06 CC03 CX05
5H027 AA06 BA01 BA09 BA17

(54)【発明の名称】　燃料電池システム

(57)【要約】
【課題】起動、停止等の運転状態でも燃料電池のセルの性能を維持することができる。
【解決手段】水素と酸素を含む空気を燃料電池セル１０６に供給して発電を行う燃料電池システム１において、燃料電池６はイオン交換膜１０７、正の触媒電極１０８及び負の触媒電極１０９とからなる電極基材Ｂを積層して構成されるセルスタック１０３と、電極基材Ｂの水過剰時に電極基材Ｂ内の水を吸収し電極基材Ｂの水不足時に電極基材Ｂに対して水を供給する水保管部Ａとからなり、水保管部Ａを電極基材Ｂに近接して配置するとともに、燃料電池６の発電停止直後に水保管部Ａにセルスタック１０３の外部から水を継続して供給し、水保管部Ａに水を保管し、燃料電池６の起動時に水保管部Ａの水を電極基材Ｂに対して供給するように構成している。



【特許請求の範囲】

【請求項１】水素と酸素を含む空気を燃料電池のセルに供給して発電を行う燃料電池システムにおいて、

前記燃料電池はイオン交換膜、正の触媒電極及び負の触媒電極とからなる電極基材を積層して構成されるセルスタックと、

前記電極基材の水過剰時に前記電極基材内の水を吸収し前記電極基材の水不足時に前記電極基材に対して水を供給する水保管部とからなり、

前記水保管部を前記電極基材に近接して配置するとともに、前記燃料電池の発電停止直後に前記水保管部に前記セルスタックの外部から水を継続して供給し、前記水保管部に水を保管し、

前記燃料電池の起動時に前記水保管部の水を前記電極基材に対して供給するように構成したことを特徴とする燃料電池システム。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】この発明は、原料を改質して水素を製造し、得られた水素を燃料電池に供給して発電を行う燃料電池システムに関する。

【０００２】

【従来の技術】燃料電池システムとして、例えば加熱器によって蒸発器を加熱し、この蒸発器で気化した原料を触媒層に供給するようにした改質装置により、原料を改質して水素を製造し、得られた水素を燃料電池に供給して発電を行うものがある。

【０００３】

【発明が解決しようとする課題】燃料電池では、起動から定常までは水過剰気味、定常状態では水不足、発電終了から停止までは水過剰気味となる。このため、それぞれの運転モードに合わせた複雑な水供給制御が必要であった。特に、起動時は、燃料電池のセルの温度上昇にともなうイオン交換膜の周辺の湿度変化が大きく、外部から水を供給しても、燃料電池のセルが冷えているために水蒸気が途中でガス通路に凝縮してしまい、電極基材のイオン交換膜を充分に加湿できなかった。

【０００４】このように、湿度制御が困難なことが、燃料電池のセルの性能が劣化したり、発電初期にセル性能が充分に出せない原因にもなっていた。

【０００５】また、多量の水を必要としたし、それによるガス通路閉塞などの悪影響も発生した。

【０００６】また、移動用に用いた場合、燃料電池のセルに必要とされる水の供給量は、負荷レベル、セル温度などにより激しく変動する。一方、加湿量は、その変化の速さに対応できない。そのため、加湿量を適正に制御することが困難であった。

【０００７】さらに、加湿不足とならないように、水を変動の最高値で供給すると水分過剰となり、電極基材であるカーボンペーパーの細孔などの、ガスの拡散通路が水で詰ってしまい、セルの性能が低下するという問題があった。また、水の変動を考慮して、平均値で水を供給すると、供給の過不足を繰返すこととなり、セルの性能が充分に出せなかった。

【０００８】この発明は、かかる点に鑑みてなされたもので、起動、停止等の運転状態でも燃料電池のセルの性能を維持することができる燃料電池システムを提供することを目的としている。

【０００９】

【課題を解決するための手段】前記課題を解決し、かつ目的を達成するために、請求項１記載の発明は、水素と酸素を含む空気を燃料電池のセルに供給して発電を行う燃料電池システムにおいて、前記燃料電池はイオン交換膜、正の触媒電極及び負の触媒電極とからなる電極基材を積層して構成されるセルスタックと、前記電極基材の水過剰時に前記電極基材内の水を吸収し前記電極基材の水不足時に前記電極基材に対して水を供給する水保管部とからなり、前記水保管部を前記電極基材に近接して配置するとともに、前記燃料電池の発電停止直後に前記水保管部に前記セルスタックの外部から水を継続して供給し、前記水保管部に水を保管し、前記燃料電池の起動時に前記水保管部の水を前記電極基材に対して供給するように構成したことを特徴としている。

【００１０】このように、起動時水保管部の水を供給するようにすることで、起動時に、水保管部がセルとほぼ同じ温度で上昇していくため、外部から水を供給するものに比べて正確な湿度管理ができる。また、停止時に、水をセルの内部または近傍に含んだ状態で保管できるので、保管中もセルの電極基材の湿度をほぼ飽和状態に保つことが可能である。

【００１１】さらに、燃料電池の水の供給制御が容易であり、かつ発電時に、負荷変動に対応した水の供給が可能となる。また、水の供給量をセルが必要な最小限度とすることができるので、水使用量の低減、水供給に必要なポンプ動力の低減、加熱量の低減、気化部、熱交換器等の小型化、水タンクの小型化が可能で、高効率・小型軽量化が可能となる。

【００１２】さらに、燃料電池の水の供給制御が容易であり、かつ発電時に、負荷変動に対応した水の供給が可能となる。また、水の供給量をセルが必要な最小限度とすることができるので、水使用量の低減、水供給に必要なポンプ動力の低減、加熱量の低減、気化部、熱交換器等の小型化、水タンクの小型化が可能で、高効率・小型軽量化が可能となる。

【００１３】

【発明の実施の形態】以下、この発明の燃料電池システムの実施例を図面に基づいて詳細に説明する。

【００１４】図１は燃料電池システムの実施例を示す構成図である。

【００１５】燃料電池システム１は、例えば電気自動車

に備えられ、燃料電池によって発生する電気を駆動源として走行するものがある。この燃料電池システム１は、メタノールタンク２、改質装置３、シフトコンバータ４、選択酸化反応器５、燃料電池６、水分回収熱交換器７、水タンク８及びコントローラ９等から構成されている。コントローラ９は、バルブ、ポンプ、ファン等の各機器及びセンサと接続されている。改質装置３、シフトコンバータ４、選択酸化反応器５、燃料電池６の各部には温度センサＴｒ、Ｔｂ、Ｔｓ、Ｔｐ、Ｔｃが備えられ、これらの温度検出により各部がコントローラ９によって適正温度に制御される。

【００１６】改質装置３には、加熱器１０、蒸発器１１、触媒層１２等が備えられている。加熱器１０には、温度センサＴｂの温度検出によりバーナーポンプ１３が駆動されてメタノールタンク２からメタノールが供給され、またバーナーファン１４の駆動で空気が供給され、これらで燃焼されて蒸発器１１を加熱する。蒸発器１１には、メタノールポンプ１５の駆動でメタノールタンク２から供給されるメタノールと、また水ポンプ１６の駆動で水タンク８から供給される水が混合して供給される。加熱器１０により蒸発器１１を加熱してメタノールと水の混合燃料を気化し、この蒸発器１１で気化した燃料を触媒層１２に供給する。

【００１７】この改質装置３により、原料を改質して水素を製造し、温度センサＴｒの温度検出により得られた水素をシフトコンバータ４、選択酸化反応器５を介して燃料電池６に供給する。改質装置３とシフトコンバータ４との間には、切換弁１７が設けられ、この切換弁１７の作動で水素が改質装置３の加熱器１０に戻される。シフトコンバータ４は温度センサＴｓの温度検出により冷却用空気ファン１８で冷却される。シフトコンバータ４から送られる水素に、反応用空気ポンプ１９の駆動で供給される空気を混合して選択酸化反応器５に供給される。選択酸化反応器５は温度センサＴｐの温度検出により冷却用空気ファン２０で冷却される。選択酸化反応器５と燃料電池６との間には、切換弁２１が設けられ、この切換弁２１の作動で水素が改質装置３の加熱器１０に戻される。

【００１８】燃料電池６には、冷却加湿ポンプ２２の駆動で水タンク８から水が供給され、また温度センサＴｃの温度検出により加圧空気ポンプ２３の駆動で水分回収熱交換器７から空気が供給され、これらの水、空気及び水素から燃料電池６で発電を行う。燃料電池６で用いられた水は、水分回収熱交換器７で熱交換で水を得て水タンク８に戻される。また、燃料電池６で発電のために用いられた水素は、改質装置３の加熱器１０に戻される。

【００１９】燃料電池システム１では、加熱器１０によって蒸発器１１を加熱し、この蒸発器１１で気化した原料を触媒層１２に供給するようにした改質装置３により、原料を改質して水素を製造し、得られた水素をシフトコンバータ４及び選択酸化反応器５を介して燃料電池６に供給して発電を行い、改質装置３は、燃料改質による反応ガスの一部を触媒層１２の途中から取り出して、戻し系３０を介して加熱器１０に戻すように構成している。戻し系３０は、触媒層１２側に設けられた反応ガス取出部３１と、この反応ガス取出部３１と加熱器１０側とを連結する配管３２と、この配管３２に備えられたバルブ３３から構成され、バルブ３３を開くことで燃料改質による反応ガスの一部を触媒層１２から取り出して加熱器１０に戻される。バルブ３３は、ＯＮ／ＯＦＦバルブまたは流量調整バルブが用いられる。

【００２０】次に、図２乃至図４に基づいて燃料電池の具体的な実施例を説明する。図２は燃料電池の正面図、図３は図２のＩＩＩ−III線に沿う断面図、図４は図２のＸ－Ｘ線及びＹ－Ｙ線に沿う断面図である。

【００２１】燃料電池６は、組付軸１０２により組み付けられたセルスタック１０３を備えている。セルスタック１０３はセパレータ１０４ａ，１０４ｂ，１０４ｃを組みにして複数積層して組み付けて構成され、セパレータ１０４ａとセパレータ１０４ｃとの間にガス遮断板１０４ｄが設けられている。セパレータ１０４ｃには、ガス遮断板１０４ｄとの間にトンネル通路１１５ｂが形成されている。セパレータ１０４ａ，１０４ｂの間には、セル１０６が備えられている。セル１０６の電極基材Ｂは、イオン交換膜１０７、正の触媒電極１０８及び負の触媒電極１０９から構成されている。イオン交換膜１０７の外周部１０７ａは、セパレータ１０４ａ，１０４ｂの間に挟んで保持され、イオン交換膜１０７の一方面には正の触媒電極１０８を有し、他方面に負の触媒電極１０９を有しており、このセル１０６により反応ガスの水素と酸素とを反応させて水を生成し、その際に電気を発生させる。

【００２２】セル１０６の正の触媒電極１０８の外側には、ポーラス部材で形成されたポーラスガイド体１１０を接触させて配置され、負の触媒電極１０９の外側にもポーラス部材で形成されたポーラスガイド体１１１を接触させて配置され、ポーラス部材で電極基材の外側に水過剰時の吸収及び水不足時の供給のための水保管部Ａを構成している。

【００２３】ポーラスガイド体１１０，１１１は多孔質なポーラス部材で成形され、それぞれ一面側には等間隔に溝１１０ａ，１１１ａが形成されている。ポーラスガイド体１１０は溝１１０ａが形成された側を正の触媒電極１０８と接触させ、ポーラスガイド体１１１は溝１１１ａをポーラスガイド体１１０の溝１１０ａと直交する方向に向けて配置されている。ポーラスガイド体１１０の溝１１０ａと正の触媒電極１０８との間に連通する反応ガス通路１１２が設けられ、ポーラスガイド体１１１の溝１１１ａと負の触媒電極１０９との間に連通する反応ガス通路１１３が設けられている。

【００２４】セルスタック１０３には、セル１０６が角度α傾斜させて配置され、セル１０６の周囲を囲むセパレータ１０４ｂ，１０４ｃの間にガスケット１１４が設けられ、ガスケット１１４によりセル１０６をシールしている。セルスタック１０３の左側上方には水素の入口部１１５が設けられ、右側下方には水素の出口部１１６が設けられ、入口部１１５及び出口部１１６の周囲を囲むようにセパレータ１０４ａ，１０４ｂとの間にガスケット１１７，１１８が設けられ、入口部１１５及び出口部１１６をシールしている。入口部１１５には、セル１０６の積層方向に入口通路１１５ａが形成され、この入口通路１１５ａから４個のトンネル通路１１５ｂがガスケット１１４の下方を通ってセル１０６の分配通路１１５ｃに連通し、分配通路１１５ｃから反応ガス通路１１３に連通している。出口部１１６には、セル１０６の積層方向に出口通路１１６ａが形成され、この出口通路１１６ａに連通された４個のトンネル通路１１６ｂはガスケット１１４の下方を通ってセル１０６の集合通路１１６ｃに連通し、集合通路１１６ｃは反応ガス通路１１３と連通している。

【００２５】セルスタック１０３の上方右側には酸素の入口部１１９が設けられ、下方左側には酸素の出口部１２０が設けられ、入口部１１９及び出口部１２０の周囲を囲むようにセパレータ１０４ａ，１０４ｂの間にガスケット１２１，１２２が設けられ、入口部１１９及び出口部１２０をシールしている。入口部１１９には、セル１０６の積層方向に入口通路１１９ａが形成され、この入口通路１１９ａから４個のトンネル通路１１９ｂがガスケット１１４の下方を通ってセル１０６の分配通路１１９ｃに連通し、分配通路１１９ｃから反応ガス通路１１２に連通している。出口部１２０には、セル１０６の積層方向に出口通路１２０ａが形成され、この出口通路１２０ａに連通された４個のトンネル通路１２０ｂはガスケット１１４の下方を通ってセル１０６の集合通路１２０ｃに連通し、集合通路１２０ｃは反応ガス通路１１２と連通している。

【００２６】また、ガス遮断板１０４ｄの図３での下面であるポーラスガイド体１１０との接触部には水通路１２３が形成されている。水通路１２３の一方１２３ａは、ガスケット１１４の下方を通るトンネル通路１２４ａを介して水素の入口部１１５の近傍で上側に設けられた排出部１２４に連通され、他方１２３ｂはガスケット１１４の下方を通るトンネル通路１２５ａを介して水素の出口部１１６の近傍で下側に設けられた供給部１２５に連通されている。排出部１２４及び供給部１２５の周囲を囲むようにセパレータ１０４ａ，１０４ｃの間にガスケット１２６ａ，１２７ａが設けられ、排出部１２４及び供給部１２５をシールしている。

【００２７】また、セパレータ１０４ｂの図３での上面であるポーラスガイド体１１０との接触部には、水通路１２８が形成されている。水通路１２８の一方１２８ａはガスケット１１４の下方を通るトンネル通路１２９ａを介して酸素の入口部１１９の近傍で右側に設けられた排出部１２９に連通され、他方１２８ｂはガスケット１１４の下方を通るトンネル通路１３０ａを介して酸素の出口部１２０の近傍で左側に設けられた供給部１３０に連通されている。排出部１２９及び供給部１３０の周囲を囲むようにセパレータ１０４ａ，１０４ｂの間にガスケット１２６ｂ，１２７ｂが設けられ、排出部１２９及び供給部１３０をシールしている。

【００２８】従って、セルスタック１０３の水素の入口部１１５から加温、加湿した水素を供給すると、この水分を含む水素は入口通路１１５ａからトンネル通路１１５ｂを通ってセル１０６の分配通路１１５ｃに導かれ、分配通路１１５ｃから反応ガス通路１１３を流れる。一方、酸素の入口部１１９から加温、加湿した酸素を供給すると、この水分を含む酸素は入口通路１１９ａからトンネル通路１１９ｂを通ってセル１０６の分配通路１１９ｃに連通し、分配通路１１９ｃから反応ガス通路１１２を流れる。

【００２９】このとき、セル１０６により反応ガスの水素と酸素の電気化学的な反応により水を生成し、その際の自由エネルギーの変化を電気エネルギーとして取り出す発電が行われる。セル１０６は、セパレータ１０４ｃを介して隣接したセル１０６と直列に接続され、発生した電力はセルスタック１０３の両端部に設けられた不図示の集電部より取り出される。

【００３０】主として水素と水はセル１０６の集合通路１１６ｃに集められ、トンネル通路１１６ｂを通って出口通路１１６ａに導かれて出口部１１６から排出される。主として酸素と水はセル１０６の集合通路１２０ｃに集められ、トンネル通路１２０ｂを通って出口通路１２０ａに導かれて出口部１２０から排出される。

【００３１】セル１０６による水素と酸素の電気化学的な反応は、一方では酸素と水がポーラスガイド体１１０、正の触媒電極１０８を通り、イオン交換膜１０７の表面に供給され、他方では水素と水がポーラスガイド体１１１、負の触媒電極１０９を通り、イオン交換膜１０７の表面に供給され、この正の触媒電極１０８とイオン交換膜１０７の界面及び負の触媒電極１０９とイオン交換膜１０７の界面で行われる。イオン交換膜１０７は、含水率により伸びが大きく変化するので、イオン交換膜１０７の加湿レベルを常に適正に保ってイオン交換膜１０７の伸びを一定に保ち、界面を安定に保つことが必要である。

【００３２】このセル１０６による反応ガスの水素と酸素の電気化学的な反応で電気が発生し、その際に水が生成されるが、このセル１０６内部の相対湿度による伸びだけではなく、内部に発生する凝縮水、生成水、供給過剰水などの過剰水が、イオン交換膜１０７に直接接触す

るとさらに伸び、セル１０６の性能が劣化するが、セル１０６の両側の触媒電極１０８，１０９にポーラスガイド体１１０，１１１を接触させて配置しており、セル１０６内部に発生する凝縮水、生成水、供給過剰水などの過剰水をポーラスガイド体１１０，１１１により吸収して除去することができる。

【００３３】このため、イオン交換膜１０７の伸びを防止でき、セル１０６の性能を長期間、高効率に保つことができ、また反応ガスの拡散性低下を防止している。このように、特別な装置を使用しないで過剰水を除去することができ、簡単、低価格、コンパクト及び軽量な装置とすることができる。ポーラスガイド体１１０，１１１により反応ガス通路１１２，１１３を形成することで、水を供給する時にポーラスガイド体１１０，１１１により吸収されて一部は反応ガス通路１１２，１１３に拡散し、一部は直接触媒電極１０８，１０９へ移動することにより加湿を効果的に行なうとともに、過剰水が発生した場合、これを吸収して不足時に供給するダンパー効果があり、適量の加湿が可能である。

【００３４】また、燃料電池６のセルスタック１０３内部に、イオン交換膜１０７、正の触媒電極１０８及び負の触媒電極１０９から構成されている電極基材の外側に水過剰時の吸収及び水不足時の供給のための水保管部Ａを設け、停止時水保管部Ａに水を保管しておき、起動時に水保管部Ａの水を供給するように構成している。

【００３５】このように、燃料電池の起動時に水保管部Ａの水を供給することで、起動時に、水保管部Ａがセル１０６とほぼ同じ温度で上昇していくため、外部から水を供給するものに比べて正確な湿度管理ができる。また、停止時に、水をセル１０６の内部または近傍に含んだ状態で水保管部Ａに保管できるので、保管中もセル１０６のイオン交換膜１０７の湿度をほぼ飽和状態に保つことが可能である。

【００３６】さらに、燃料電池６の水の供給制御が容易であり、かつ発電時に、負荷変動に対応した水の供給が可能となる。また、水の供給量をセル１０６が必要な最小限度とすることができるので、水使用量の低減、水供給に必要なポンプ動力の低減、加熱量の低減、気化部、熱交換器等の小型化、水タンクの小型化が可能で、高効率・小型軽量化が可能となる。

【００３７】また、起動時水保管部Ａに水を保管しておき、定常時水保管部Ａの水を供給するように構成している。このように、定常時水保管部Ａの水を供給するようにすることで、起動時に、凝縮水や過剰水を確保でき、加湿水の供給量を低減できる。また、起動中、加湿に寄与しない水がガス通路から除去されるので、発電開始から性能を高く維持できる。

【００３８】さらに、燃料電池６の水の供給制御が容易であり、かつ発電時に、負荷変動に対応した水の供給が可能となる。また、水の供給量をセルが必要な最小限度とすることができるので、水使用量の低減、水供給に必要なポンプ動力の低減、加熱量の低減、気化部、熱交換器等の小型化、水タンクの小型化が可能で、高効率・小型軽量化が可能となる。

【００３９】図５乃至図８は水保管部の他の実施例を示している。図５の水保管部Ａは、多層構造になっており、第１保管部Ａ１は通路３００を有するポーラス部材で形成され、第２保管部Ａ２も同様にポーラス部材で形成されている。水は、第１保管部Ａ１の通路３００から第２保管部Ａ２に吸収して保持されるが、第１保管部Ａ１が第２保管部Ａ２より水の吸収が良く、水保管部Ａを多層構造にすることで保水量を増やしている。

【００４０】図６の水保管部Ａも、多層構造になっており、第１保管部Ａ１は同様に通路３００を有するポーラス部材で形成され、第２保管部Ａ２はポーラス部材または不浸透材で形成されている。第２保管部Ａ２の第１保管部Ａ１側に凹部を有しており、この凹部と第１保管部Ａ１との間に空間が形成され、この空間で通路３０１を形成している。水は、第１保管部Ａ１の通路３００から第２保管部Ａ２に吸収して保持されるが、さらに通路３０１によって水が多量に且つ確実に保持される。

【００４１】図７の水保管部Ａも、多層構造になっており、第１保管部Ａ１は通路３００を有するポーラス部材で形成され、第２保管部Ａ２も同様にポーラス部材で形成されているが、この第２保管部Ａ２の外側に不浸透材Ｃが配置されている。第１保管部Ａ１には通路３００の間に、電極基材Ｂの外側と第２保管部Ａ２とを連通するガイド通路３０２が形成されている。また、第２保管部Ａ２には、不浸透材Ｃとの間に水通路３０３が形成されている。従って、負圧で引くことによって、第１保管部Ａ１に水が通路３００から吸収され、さらにガイド通路３０２により第２保管部Ａ２に吸収され、水の吸収が速くなっている。

【００４２】図８の水保管部Ａも、多層構造になっており、第１保管部Ａ１は通路３００を有するポーラス部材で形成され、この第１保管部Ａ１の外側に不浸透材Ｃが配置されている。不浸透材Ｃには、第１保管部Ａ１との間に水通路３０４が形成され、水が水通路３０４から第１保管部Ａ１に円滑に供給される。

【００４３】図９及び図１０は水保管部Ａの配置位置を示している。図９の実施例では、電極基材で構成されるセル１０６の両側にガス通路４００が形成されており、このガス通路４００の空間内に水保管部Ａが形成されている。このように、水保管部Ａが電極基材のセル１０６から離れた位置に配置され、水ポンプ４０１により供給される水は水保管部Ａに保管される。

【００４４】図１０の実施例では、電極基材で構成されるセル１０６の両側に、水素の入口部１１５と、水素の出口部１１６が設けられている。入口部１１５には、セル１０６の積層方向に入口通路１１５ａが形成され、こ

の入口通路１１５ａから４個のトンネル通路１１５ｂがセル１０６の分配通路１１５ｃに連通され、この入口側に水保管部Ａが形成される。

【００４５】また、出口部１１６には、セル１０６の積層方向に出口通路１１６ａが形成され、この出口通路１１６ａから４個のトンネル通路１１６ｂがセル１０６の集合通路１１６ｃに連通され、この出口側に水保管部Ａが形成される。

【００４６】次に、図１１に基づき燃料電池システムの運転について説明する。図１１（ａ）において、特性曲線ａ１は従来の運転を、特性曲線ｂ１、ｃ１はそれぞれ本発明を示している。また、図１１（ｂ）において、特性曲線ａ２は従来の運転を、特性曲線ｂ２、ｃ２はそれぞれ本発明を示している。

【００４７】従来のものでは、停止時において、燃料電池システムの停止操作直後に、燃料電池への水蒸気の供給を徐々に停止する。保管時において、周囲の温度により、セル内部の湿度が変化する。温度が低下により徐々に飽和湿度に近づき、それを越えると水分が凝縮して通路などを閉塞する。また、温度が上昇しても凝縮水が偏在しているため、電極基材の膜への加湿効果は少ない。起動時において、発電開始に先だって、外部から水（または水蒸気）を供給するための準備（ポンプを駆動して、加熱または熱交換により水蒸気を作る。）を行っておく。発電開始にともない、セルの温度を適正温度まで上昇させるとともに、外部から水（または水蒸気）を供給していく。発電時において、出力及びセルの温度などに応じて、水分供給量を変える必要があるため、頻繁に加湿量を変えなくてはならない等の問題がある。

【００４８】本発明の燃料電池システム１である図１１（ｂ）の実施例では、燃料電池の発電停止時において、燃料電池の外部からの（水）水蒸気の供給を停止せず、発電時と同じかまたはそれ以上の流量を送り続け、水保管部Ａに水として吸収させる。保管時において、周囲の温度による飽和湿度に保たれ、凝縮分は、さらに吸収される。起動時において、発電開始にともない、セル１０６の温度を適正温度まで上昇させる。これには、外部加熱または自己発熱を用いる。外部からの水（または水蒸気）供給は初期には行わず、水保管部Ａの水を利用する。水保管部Ａの水は、セル温度の上昇とともに温度が上昇し、ガス通路へ蒸発していく。これにより、ガス通路は飽和湿度近くに保たれる。保管水の自然蒸発による加湿だけでは、時間的に限界があるので、起動時間を短縮するために、一定時間経過後、外部から水（または水蒸気）を供給していく。発電時において、水分の吸収・放出効果を利用できるので、頻繁に加湿量を変えなくても適正加湿制御が可能である。

【００４９】また、図１１（ｃ）の実施例では、停止時において、システムの停止操作直後に、水（水蒸気）の供給を徐々に停止する。保管時において、周囲の温度による飽和湿度に保たれる。凝縮分は、さらに吸収される。起動時において、発電開始に先だって、外部から水（または水蒸気）を供給するための準備（ポンプを駆動して、加熱または熱交換により水蒸気を作る。）を行っておく。発電開始にともない、セルの温度を適正温度まで上昇させるとともに、外部から水（または水蒸気）を供給していく。水保管部Ａの水を多少利用できるため、外部からの水（または水蒸気）供給は初期には行わず水保管部Ａの水を利用する。そのため水供給量は従来に比べて少なくて済む。水を供給しながら、水保管部Ａに水を保管しておき後で湿度管理に使う。発電時において、水分の吸収・放出効果を利用できるので、頻繁に加湿量を変えなくても適正加湿制御が可能である。

【００５０】図１２は燃料電池システムの他の実施例を示す構成図である。この実施例の燃料電池６は、図１と同様に構成されるが、図１と異なりエア用ポンプ５００の駆動で改質装置３に配置される加熱部５０１に水タンク８から空気を送り、この加熱部５０１で加熱された空気を燃料電池６の入口側５０２に送るように構成されている。また、水用加湿ポンプ５１０の駆動で改質装置３に配置される加熱部５１１に水タンク８から水を送り、この加熱部５１１で加熱された水を燃料電池６の入口側５１２に送るように構成されている。

【００５１】燃料電池６では、水素側は入口が水分多く、また空気側は出口が水分多くなる。このため、所定のタイミングでエア用ポンプ５００の駆動で改質装置３に配置される加熱部５０１に送り、この加熱部５０１で加熱された空気を燃料電池６の入口側５０２に送る。また、所定のタイミングで水素用加湿ポンプ５１０の駆動で改質装置３に配置される加熱部５１１に水タンク８から水素を送り、この加熱部５１１で加熱された水素を燃料電池６の入口側５１２に送る。

【００５２】このように、エア用ポンプ５００及び水用加湿ポンプ５１０の駆動による入換え、これにより水分を均一に保つことができ、この入換えのタイミングは、一定時間おき、一定電流量発生後、一定電力量発生後、負荷が０（または一定値以下）になる度毎、或は起動／停止の度毎に行なう。この空気の入換えは、バルブ５０３，５０４の作動で行ない、また水素の入換えは、バルブ５１３，５１４の作動で行なう。

【００５３】

【発明の効果】前記したように、請求項１記載の発明は、燃料電池はイオン交換膜、正の触媒電極及び負の触媒電極とからなる電極基材を積層して構成されるセルスタックと、電極基材の水過剰時に電極基材内の水を吸収し電極基材の水不足時に電極基材に対して水を供給する水保管部とからなり、水保管部を電極基材に近接して配置するとともに、燃料電池の発電停止直後に水保管部にセルスタックの外部から水を継続して供給し、水保管部に水を保管し、燃料電池の起動時に水保管部の水を電極

基材に対して供給するように構成し、起動時に水保管部の水を供給するから、起動時に、水保管部がセルとほぼ同じ温度で上昇していくため、起動時に外部から水を供給するものに比べて正確な湿度管理ができる。また、発電停止時に、水をセルの内部または近傍に含んだ状態で保管できるので、保管中もセルのイオン交換膜の湿度をほぼ飽和状態に保つことが可能である。

【００５４】さらに、燃料電池の水の供給制御が容易であり、かつ発電時に、負荷変動に対応した水の供給が可能となる。また、水の供給量をセルが必要な最小限度とすることができるので、水使用量の低減、水供給に必要なポンプ動力の低減、加熱量の低減、気化部、熱交換器等の小型化、水タンクの小型化が可能で、高効率・小型軽量化が可能となる。

【００５５】起動時に、凝縮水や過剰水を確保できるので、加湿水の供給量を低減できる。また、起動中、加湿に寄与しない水がガス通路から除去されるので、発電開始から性能を高く維持できる。

【００５６】また、燃料電池の水の供給制御が容易であり、かつ発電時に、負荷変動に対応した水の供給が可能となる。また、水の供給量をセルが必要な最小限度とすることができるので、水使用量の低減、水供給に必要なポンプ動力の低減、加熱量の低減、気化部、熱交換器等の小型化、水タンクの小型化が可能で、高効率・小型軽量化が可能となる。

【図面の簡単な説明】

【図１】燃料電池システムの実施例を示す構成図である。

【図２】燃料電池の正面図である。

【図３】図２のIII-III線に沿う断面図である。

【図４】図２のＸ－Ｘ線及びＹ－Ｙ線に沿う断面図である。

【図５】水保管部の他の実施例を示す図である。

【図６】水保管部の他の実施例を示す図である。

【図７】水保管部の他の実施例を示す図である。

【図８】水保管部の他の実施例を示す図である。

【図９】水保管部の配置を示す他の実施例を示す図である。

【図１０】水保管部の配置を示す他の実施例を示す図である。

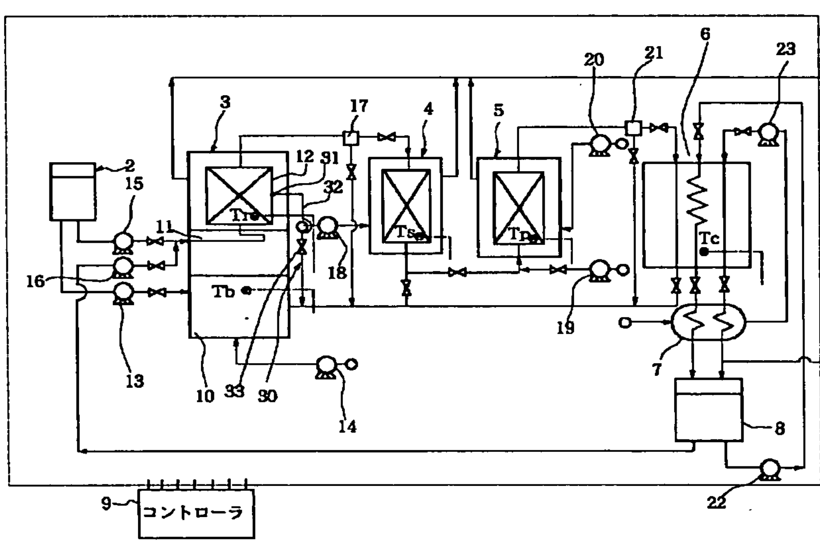
【図１１】燃料電池システムの運転について説明するずである。

【図１２】燃料電池システムの他の実施例を示す構成図である。

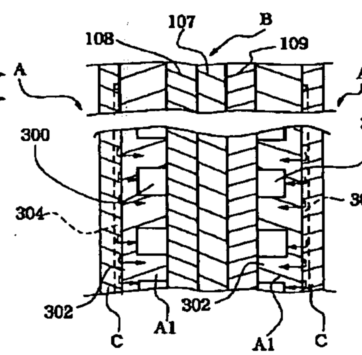
【符号の説明】

１　燃料電池システム
６　燃料電池
１０３　セルスタック
１０６　燃料電池セル
１０７　イオン交換膜
１０８　正の触媒電極
１０９　負の触媒電極
Ｂ　電極基材
Ａ　水保管部

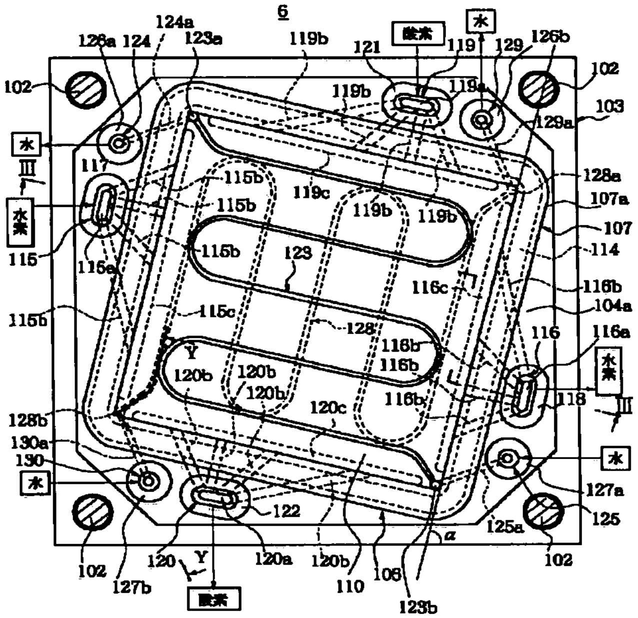
【図１】



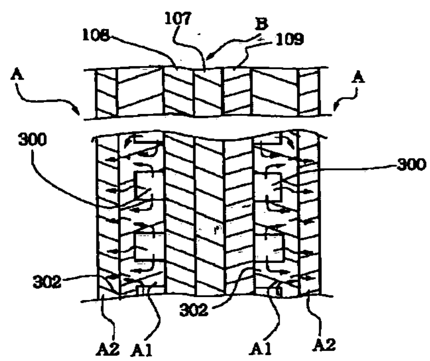
【図８】



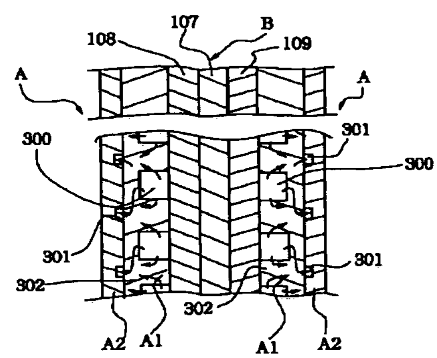
【図２】



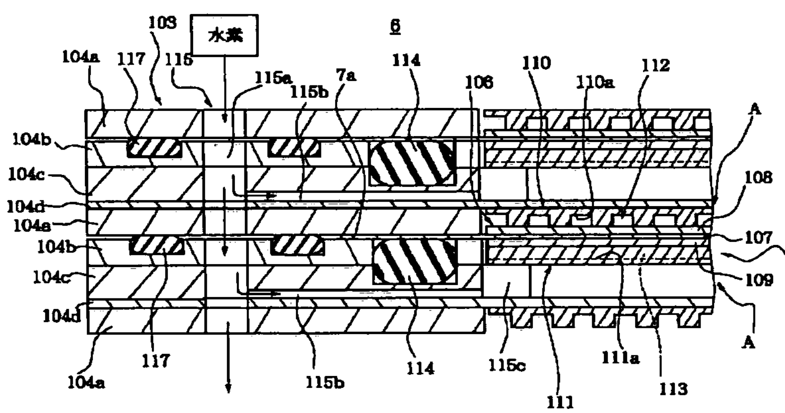
【図５】



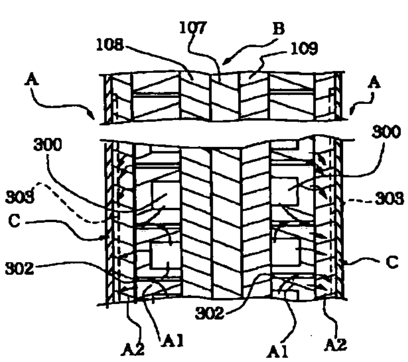
【図６】



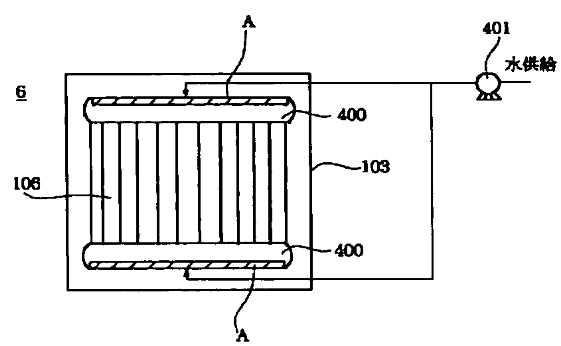
【図３】



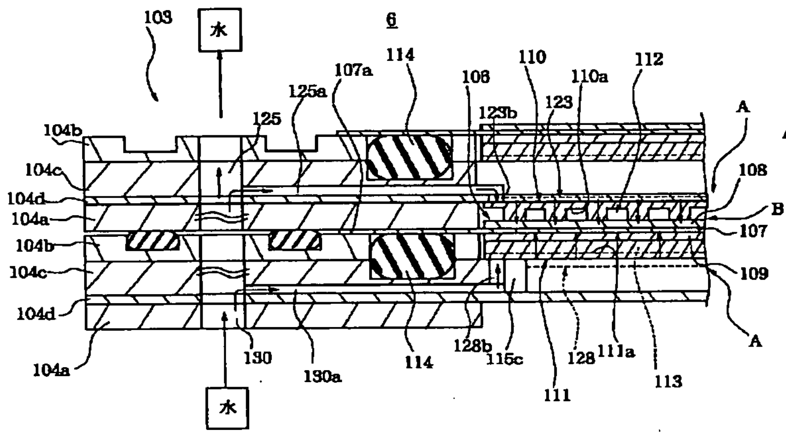
【図７】



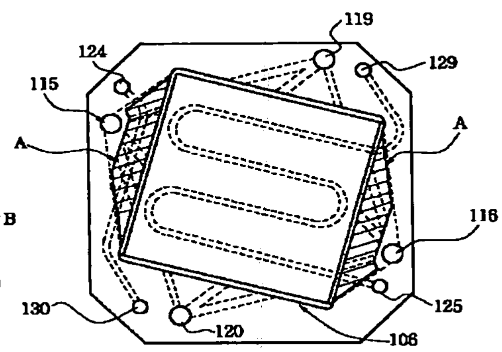
【図９】



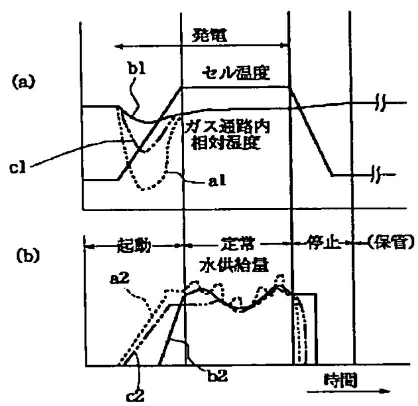
【図４】



【図１０】



【図１１】



【図１２】